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# Potential of improved banana cultivars as a food security and income generating crop: preliminary results on adoption of the cultivars

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## Abstract

**The East African Highland banana, an important stable food in Uganda, is susceptible to weevils, black Sigatoka and nematodes. Host plant resistance has been identified as the most appropriate solution to these problems and selection of resistant clones from introduced germplasm adopted as one of the means of developing the intervention. Eleven promising clones selected from foreign introductions were evaluated in 13 districts of Central Eastern and North Eastern Uganda. The farming communities evaluated the clones for cooking, roasting, juice extraction and dessert qualities. Five of the clones were selected on the basis of bunch size and use. They noted that although the new bananas were not as good in taste as the East African Highland banana they were as good as other starchy foods in their areas. The introduced bananas were acclaimed for the advantages of being higher yielding than all the food crops known to the farming communities. The selected clones are currently diffusing fast in the areas. This paper describes the progress to date on promotion and diffusion of the selected clones.**

**Key words:** Introduced bananas, Evaluation, Use, Promotion, diffusion

## Introduction

Banana is one of the most important food crop in Uganda. Annual production is estimated at 9.8 million tonnes, accounting for 11% of total world production (INIBAP, 1999). The crop is grown on 1.6 million ha, equivalent to 38% of land under crops(Anon. 1998). Percapita consumption in Uganda is estimated at 143 kg, one of the highest in the world, and, which indicates how dependent Uganda is on the crop (FAO, 1998). The banana is also an important cash crop, contributing up to 22% of national agricultural rural revenue and alternating with coffee as a leading family income earner in many areas (Bagamba, 1994). It has a high industrial potential through juice, wine, waragi (local distilled spirits) and assorted value added foodstuffs (Gensi et al., 1994; Aked and Kyamuhangire, 1996). Additionally, traditional banana farming systems are *considered productively sustainable and environment-friendly (Karamura, 1993).*

Despite its importance, banana productivity in the traditional banana growing areas has steadily declined since the 1970s (FAO, 1991). This decline threatens the food security and cash income of the people. Banana yields stand at 4.5 to 6.0 t $ha^{-1}$ compared to the potential 60 to 90 t $ha^{-1}$ (KARI, 1996). The decline is mainly attributed to decline in soil fertility, pests (weevils and plant parasitic nematodes) and diseases (black sigatoka banana streak virus and Fusarium wilt).

Weevil infestation can cause 50 to 100% yield loss and reduced span of the plantation (Sebasigari and Stover, 1988; Gold et al., 1993), while yield loss up to 50% due to nematodes has been reported on the highland bananas (Speijer and Kajumba, 1996). Black sigatoka, caused by the air borne fungus *Mycosphaerella* fijiensis Morelet, has become the most important disease of highland bananas (Tushemereirwe and Waller, 1993) and causes yield loss of up to 40% in Uganda (Tushemereirwe, et al., 2000). Banana streak disease caused by a badnavirus was first reported in Uganda in

1996 (Tushemereirwe et al., 1996) and is considered an economically important disease world wide. Fusarium wilt (Fusarium oxysporium f.sp. cubense) is a soil borne disease that has been reported on imported clones ('Pisang awak', 'Gros Michel', 'Kisubi' and 'Sukali Ndiizi') for a long time but not on highland banana landraces.

Host plant resistance was identified as the most appropriate intervention and since 1994, efforts to develop/select resistant clones have been in progress (NARO-Uganda, 2001). The efforts have centered on two options of developing this intervention: incorporating resistance into the Highland bananas through cross breeding and selecting appropriate clones from foreign introductions. Banana breeding is a slow process which takes several years to yield an acceptable product. As such, the breeding option has not yet yielded resistant clones good enough for use by farmers. However, interesting clones have been selected from foreign introductions.

All germplasm obtained from outside Uganda must undergo evaluation for performance and acceptability on station and multilocationally before superior ones are officially released. Germplasm evaluation has traditionally been carried without involving farmers initially, until much later. This traditional approach not only often eliminates materials that could have been found acceptable by farmers, but also, sometimes present farmers with varieties that do not meet their requirements. This system is slow in delivering superior materials to end-users. Therefore, it is important to involve farmers early in the evaluation process. This paper describes the multilocation evaluation of introduced banana germplasm based on farmer participation in Uganda.

## Materials and methods

Many exotic and hybrid banana genotypes were introduced into Uganda through the International Musa Testing

**Table 1. Bunch weight, acceptability and disease reaction for hybrids/cultivars selected for multilocational evaluation**

| | | | | Acceptability[2] | | | | |
|---|---|---|---|---|---|---|---|---|
| **Name** | **Genome** | **Origin** | **BWT (Kg)[1]** | **Cooking** | **Dessert** | **Juice** | **Sig[1] (%)** | **Fus[3]** |
| KABANA 1H (FHIA 01) | AAAA | FHIA | 45.6 | 3.2 | 3.0 | 63.4 | R | T |
| KABANA 3H (FHIA 17) | AAAA | FHIA | 43.9 | 3.0 | 2.0 | 0.0 | R | R |
| KABANA 4H (FHIA 23) | AAAA | FHIA | 45.4 | 3.2 | 2.0 | 0.0 | R | R |
| TMPx 7002 | AAAB | IITA | 25.4 | 5.5 | 5.3 | 0.0 | R | - |
| *Mbwazirume | AAA | Landrace | 15.6 | 2.1 | ND | ND | S | R |
| *Kisansa | AAA | Landrace | 16.5 | 1.3 | ND | ND | S | R |
| #Gros Michel | AAA | - | - | ND | 2.1 | ND | S | S |
| #Sukali Ndiizi | AB | - | - | ND | 1.3 | ND | S | S |
| KABANA 5 (Yangambi Km 5) | AAA | INIBAP | 25.1 | 4.7 | 3.7 | 67.1 | R | R |
| +Kisubi | AB | - | 12.6 | ND | ND | 52.7 | T | S |
| +Pisang awak | ABB | - | 14.2 | ND | ND | 60.5 | R | S |
| +Entundu | AAA | Landrace | 16.1 | ND | ND | 68.5 | S | R |

S = Susceptible, T = Tolerant, R = Resistant
BWT = Bunch weight
IITA = International Institute of Tropical Agriculture
FHIA = Foundacion Hondurena Internatinale Agricole
INIBAP = International Network for the Improvement of Banana and Plantain
ND = Not determined because cultivar is traditionally known for not being used for that purpose
Sig = Sigatoka
Fus = Fusarium
Scale for acceptability as cooking and dessert: 1= Extremely good, 6 = Extremely poor
* = Cultivars used as control for cooking tests
+ =Cultivars used as control for juice tests
- = Data not available
# = Cultivar used as control for dessert tests
1: KARI, 1999
2: Nowakunda, 2000
3: Tushemereirwe et al., 2000

Program of INIBAP. The genotypes were screened at Kawanda Agricultural Research Institute and Seven promising genotypes selected for multilocation evaluation. They included 'TMPx 7002-1', 'KABANA 1H' (FHIA 01), 'KABANA 2H' (FHIA 03), 'KABANA 3H' (FHIA 17), 'KABANA 4H' (FHIA 23), FHIA 21 and 'KABANA 5'(Yangambi Km 5), whose characteristics are indicated in Table 1. Two promising IITA hybrids, i.e., 'TMPx 4479-1', and 'TMPx 7152-2', TMBx (IITA-ESARC, 1997, 1998) and two other virus tested and promising IITA hybrids, i.e. 'TMBx 1378' and 'TMBx 5295-1' were also included in the trial. The most popular landraces (Kisansa, Mpologoma, Namaliga, Musakala, Kibuzi, Mbwazirume, Nakitembe) were included as local checks.

In order to reduce the time required to get the promising genotypes to end users, a system that enabled farmers to participate in multilocational testing was designed. In this system, evaluation plots of quarter acre each were planted on farmers' fields, in which the main evaluator at the different locations was the farmer, assisted by the extension staff and the researchers. The farmers managed and maintained the plots, collected yield data (bunch weight, number of hands per bunch and number of leaves at harvest).

**Fig. 1 KABANA 3H**

They also evaluated the genotypes for a range of potential uses and recorded the most appropriate one. The researchers provided planting materials, weighing scales, record books and technical backstopping. The extension staff gave farmers advice on husbandry practices.

The trials were conducted in 14 districts of Uganda selected from the North-East, East, Central and Western parts of Uganda, cutting across the various agro-ecological zones of the country. The genotypes were planted on farmers' fields in lines of 10 plants per genotype, at four sites in each district in1998 and 1999. Farmers were selected through consultation with extension staff, local leaders, Non-Governmental Organisations operating in the area and farmers themselves. Farmers were selected on the basis of their willingness to participate, interest in the project and commitment and seriousness with other similar projects.

Data were analysed by SAS statistical programme (Anon, 1994)

## Results

### Growth and yield

Banana genotypes that performed well on station also did so in the multilocational evaluation trial **(Table 2)**. In general, the introduced genotypes had more functional leaves at maturity than the local checks. The introduced hybrids therefore had less leaf spot diseases and hence more leaf area for photosynthesis. Preliminary yield results based on district means indicated that the biggest bunches were obtained from 'KABANA 3H', 'KABANA 4H' and 'KABANA 1H' in that order, with average bunch weights of more than 25 Kg while average bunch weights of highland bananas were less than 20 Kg. At most sites, farmers noted that the hybrids from FHIA were shorter and thicker in pseudostem girth, and therefore more resistant to stem lodging, easier to support with stakes, easier to detrash and easier to harvest than the rest of the genotypes.

### Acceptability

Farmers selected as "acceptable" genotypes that had shown potential for acceptance on station for different purposes. Three FHIA hybrids ('KABANA 1H', 'KABANA 3H' and 'KABANA 4H') were accepted as cooking bananas (Table 3). The hybrids had also been found superior to the highland cooking bananas in terms of resistance to Black Sigatoka and no symptoms of Banana Streak Virus (BSV) were observed on them (KARI, 1999). The same hybrids were also preferred as dessert bananas and can be good replacements for 'Gros Michel', which is highly susceptible to Fusarium wilt (Tushemereirwe et al., 2000).

Three genotypes namely 'KABANA 2H', 'KABANA 5' and 'TMPx 4479' were preferred for juice production (Table 3). However, 'KABANA 2H' succumbed to Fusarium wilt (Tushemereirwe et al., 2000) while 'TMPx 4479' showed BSV symptoms in some districts. Thus, the most suitable replacement for highland banana juice cultivars that are low yielding and highly susceptible to Fusarium wilt is 'KABANA 5'. It is also a suitable replacement for 'Kisubi', a very low yielding and Fusarium susceptible locally available clone. 'Pisang awak', a moderately yielding and Fusarium wilt susceptible locally available clone can also be replaced by 'KABANA 5'. In Uganda, preliminary results have indicated that 'KABANA 5' is resistant to weevils (Kiggundu, 2000). No BSV symptoms were observed on 'KABANA 5' in the multilocational testing. Research elsewhere also indicated that the cultivar was resistant to *Radopholus* similis (Fogain and Gowen, 1998, Stoffelen et al., 2000), the most damaging banana nematode in Uganda.

Therefore, it is a suitable cultivar in disease and pest infested areas of Uganda. Systematic evaluation of the introduced banana types for reaction to weevils and nematodes began in 2000 on station.

Although the hybrids were developed for resistance to Fusarium wilt and /or black sigatoka (Rowe, 1990; Vuylsteke et al., 1993), some of them may be either tolerant or resistant to weevils / nematodes. This is because some of the multilocational trials were conducted in farmers' fields that were believed to have high pest populations or were near fields infested with pests, but still performed well.

**Dissemination**

In most districts, farmer to farmer dissemination has been taking place (Table 4). The most active sites include Dokolo (Lira District), Usukuru (Tororo District), Nawanyago (Kamuli District), Ssi (Mukono District), Mabone and Kyabigambire (Hoima District), Butebo (Pallisa District) and Kagoma, Busedde (Jinja District). The demand for some of the cultivars is alarmingly high. The limitation appears to be the number of plants that can be obtained from the plots. In all these sites, the original plots have been over-de-suckered due to the high demand and good price for the suckers of some the cultivars as KABANA 3H. Extension workers in these sites have requested the National Banana Research Programme to assist them set up many more mother garden using the cultivars the farmers have selected (KABANA 3H, KABANA 4H, Mporogoma/Mudwaale, Kisansa and Musakala mainly), this time, at parish level to be able to meet current demands. The data presented in table 4 is based on primary (original) plots of 40 plants per cultivar in a district. Dissemination from secondary and tertiary plots is also going on rapidly but data to capture this aspect has not yet been collected

The beneficiaries from the original plots were both from the neighborhoods and also from far places including people from different counties and districts in some cases. The importance or scarcity of the cultivars is also indicated by the price of a sucker. Note that KABANA 3H costs higher than any other cultivars at most of the sites. Similarly, the average price of a bunch of KABANA 3H is Shs. 10,000=, many times higher than other bananas in Ssi-Mukono, Hoima and Tororo.

**Table 2. Agronomic characteristics and the price ranges for bunches in the different ones.**

| ZONE | Genotype lowering | Mean Girth at harvest | Mean Heightt at flowering | Mean Leaves Weights (kg) | Mean Bunch Bunches | Price range for |
|---|---|---|---|---|---|---|
| Eastern & Mid Northern | | | | | | |
| | KABANA 1H | 55.2±2.8 | 288.1±10.1 | 7± 0.7 | 22.0± 4.0 | 0.0 |
| | KABANA 3H | 60.0±7.7 | 372.0±12.6 | 10±0.3 | 28.9± 4.9 | 5,000-10,000= |
| | KABANA 2H | 52.7±5.3 | 275.3±8.7 | 8± 0.5 | 27.5± 5.1 | 0.0 |
| | KABANA 4H | 58.0±7.6 | 342.8±8.9 | 9± 1.0 | 25.0± 3.2 | 2,000-5,000= |
| | KABANA 5 | 36.7±4.0 | 299.2±10.5 | 8± 0.7 | 6.5± 2.0 | 0.0 |
| | FHIA 21 | 37.0±4.4 | 279.9±8.4 | 5± 0.3 | 5.5± 2.2 | 0.0 |
| | Pita 8 | 36.7±6.3 | 240.2±14.0 | 4± 0.3 | 7.5± 1.8 | 0.0 |
| | Pita 14 | 41.0±5.7 | 252.6±15.4 | 3± 0.3 | 8.4± 2.1 | 0.0 |
| | Pita 17 | 43.5±2.5 | 270.5±6.2 | 4± 0.2 | 9.7± 2.8 | 0.0 |
| | Bita 2 | 49.7±4.0 | 277.9±8.9 | 5± 0.2 | 7.8± 3.1 | 0.0 |
| | Bita 3 | 42.7±3.4 | 288.4±9.3 | 0.0 | 0.0 | 0.0 |
| | Kisansa | 39.0±4.6 | 315.2±8.7 | 2±0.5 | 16.5± 2.4 | 500= -3,00= |
| | Mbwazirume | 42.0±3.3 | 311.5±11.2 | 1± 0.2 | 11.7± 5.0 | 500= -3,000= |
| | Musakala | 45.0±41 | 333.4±7.9 | 3± 0.7 | 14.6± 4.5 | 500= -3,000= |
| | Mpologoma | 57.2±1.8 | 322.5±8.7 | 2± 0.9 | 15.7± 3.4 | 500= -3,000= |
| | Namaliga | 48.7±5.0 | 354.6±9.7 | 4± 0.6 | 10.5± 4.9 | 500= -3,000= |
| Lake Victoria and Lake Alber t crescent | KABANA 1H | 37.0±4.3 | 279.9±8.9 | 5±0.2 | 25.5±4.5 | 0.0 |
| | KABANA 2H | 80.2±5.2 | 288.7±8.5 | 8±0.6 | 20.5± 6.8 | 0.0 |
| | KABANA 3H | 56.8±2.8 | 325.1±7.9 | 9±0.6 | 38.0± 3.1 | 5,000-15,000= |
| | KABANA 4H | 40.2±3.1 | 315.2±12.3 | 7±0.4 | 29.0± 6.1 | 4,000-10,000= |
| | KABANA 5H | 39.7±4.9 | 322.0±19.7 | 10±0.9 | 7.9± 3.6 | 0.0 |
| | FHIA 21 | 76.7±2.0 | 289.8±9.0 | 3±0.2 | 7.8± 4.1 | 0.0 |
| | Pita 8 | 36.0±5.0 | 278.3±11.2 | 3±0.2 | 5.0± 2.2 | 0.0 |
| | Pita 14 | 41.2±3.7 | 322.5±8.7 | 4±0.3 | 5.4± 4.7 | 0.0 |
| | Pita 17 | 39.0±2.9 | 300.2±.4.5 | 4±0.5 | 8.0± 0.9 | 0.0 |
| | Bita 2 | 37.2±4.3 | 198.9±10.2 | 7±0.7 | 8.8± 4.1 | 0.0 |
| | Bita 3 | 39.8±8.2 | 158.7±7.2 | 0.0 | 0.0 | 0.0 |
| | Kisansa | 39.7±2.9 | 284.2±6.0 | 1±0.1 | 18.5±6.4 | 500= -3,500= |
| | Mbwazirume | 36.8±5.3 | 312.5±11.0 | 2±0.4 | 12.6± 5.8 | 500= -3,500= |
| | Musakala | 31.5±3.5 | 313.2±7.9 | 2±0.4 | 17.5± 5.0 | 500= -3,500= |
| | Mpologoma | 44.0±5.3 | 300.0±5.2 | 3±0.2 | 19.9± 5.8 | 500= -3,500= |
| | Namaliga | 40.2±2.4 | 287.3±10.5 | 2±0.3 | 16.0± 4.9 | 500= -3,500= |
| Southern Western highlands/and Drylands | KABANA 1H | 45.8±2.4 | 300.0±8.0 | 9±1.0 | 35.0± 3.9 | 0.0 |
| | KABANA 2H | 45.0±3.4 | 298.3±12.8 | 7±0.8 | 30.2± 4.7 | 0.0 |
| | KABANA 3H | 60.2±4.6 | 398.1±12.7 | 8±0.4 | 42.0± 2.9 | 0.0 |
| | KABANA 4H | 58.7±3.7 | 317.2±6.8 | 10±0.6 | 35.8± 7.1 | 0.0 |
| | KABANA 5H | 25.9±5.6 | 158.2±9.8 | 10±0.9 | 11.2± 4.5 | 0.0 |
| | FHIA 21 | 36.3±3.1 | 301.2±7.9 | 7±0.5 | 8.0± 1.8 | 0.0 |
| | Pita 8 | 33.1±4.6 | 199.8±8.7 | 5±0.3 | 7.0± 1.2 | 0.0 |
| | Pita 14 | 49.2±4.0 | 198.0±9.0 | 4±0.2 | 7.5± 1.8 | 0.0 |
| | Pita 17 | 41.2±6.5 | 200.1±4.6 | 7±0.4 | 11.0± 2.8 | 0.0 |
| | Bita 2 | 38.7±2.5 | 187.9±11.9 | 6±0.5 | 10.1± 1.7 | 0.0 |
| | Bita 3 | 28.3±5.0 | 210.2±11.1 | 0.0 | 0.0 | 0.0 |
| | Kisansa | 44.0±5.5 | 351.0±9.6 | 3±0.2 | 22.0± 4.0 | 500= -3,500= |
| | Mbwazirume | 39.2±3.8 | 332.5±7.4 | 2±0.3 | 18.6± 6.8 | 500= -3,500= |
| | Musakala | 41.2±3.0 | 342.1±6.9 | 2±0.3 | 20.5± 5.7 | 500= -3,500= |
| | Mpologoma | 51.2±5.8 | 345.8±12.0 | 2±0.2 | 21.0± 2.1 | 500= -3,500= |
| | Namaliga | 35.2±8.3 | 302.1±11.7 | 2±0.3 | 16.0± 4.5 | 500= -3,500= |

**Table 3. Uses and level of acceptance for the introduced banana clones in Eastern & Mid Northern, Lake Victoria and Lake Albert crescent and Southern & Western highlands agro-ecological zones.**

| | Eastern & Mid Northern | | | | Lake Victoria and Lake Albert crescent | | | | Southern & Western highlands/Western Drylands | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Genotypes | Cooking | Juice | Dessert | Roasting | Cooking | Juice | Dessert | Roasting | Cooking | Juice | Dessert | Roasting |
| KABANA 1H | ** | * | ** | | * | ** | ** | | * | ** | ** | |
| KABANA 2H | | *** | * | | | *** | | | | *** | | |
| KABANA 3H | *** | | *** | | * | | *** | | * | | *** | |
| KABANA 4H | *** | | *** | | * | | *** | | * | | *** | |
| KABANA 5 | | *** | ** | | | *** | ** | | | *** | ** | |
| FHIA 21 | | | | ** | | | | ** | | | | * |
| Pita 8 | | | | * | | | | * | | | | * |
| Pita 14 | | ** | | * | | ** | | * | | ** | | |
| Pita 17 | | | | * | | | | * | | | | * |
| Bita 2 | | ** | | | | ** | | | | ** | | |
| Bita 3 | | | | | | | | | | | | |
| Kisansa | **** | | | | **** | | | | **** | | | |
| Mbwazirume | **** | | | | **** | | | | **** | | | |
| Musakala | **** | | | | **** | | | | **** | | | |
| Mpologoma | **** | | | | **** | | | | **** | | | |
| Namaliga | **** | | | | **** | | | | **** | | | |

* = Low acceptability
** = Medium acceptability
*** = High acceptability
No star = Not acceptable

**Table 4. Farmer to farmer dissemination of banana cultivars and prices offered by recipients in 13 Districts of Uganda, September, 2001.**

| Zone | Cultivar | No. Supplied | Total suckers Disseminated | Given Free | Sold | Average Price/ sucker |
|---|---|---|---|---|---|---|
| Eastern & Mid Northern | | | | | | |
| | KABANA 1H | 110 | 318 | 120 | 198 | 750= |
| | KABANA 2H | 110 | 189 | 101 | 88 | 500= |
| | KABANA 3H | 110 | 502 | 213 | 289 | 1.000= |
| | KABANA 4H | 110 | 432 | 183 | 249 | 850= |
| | Mpologoma | 110 | 473 | 236 | 237 | 600= |
| | Kisansa | 110 | 372 | 163 | 209 | 450= |
| | Musakala | 110 | 449 | 193 | 256 | 450= |
| | Totals | 770 | 2,735 | (393) | 1,209 | 1,526 |
| Lake Victoria and Lake Albert crescent | | | | | | |
| | KABANA 1H | 240 | 372 | 108 | 264 | 500= |
| | KABANA 2H | 240 | 40 | 25 | 15 | 500= |
| | KABANA 3H | 240 | 862 | 80 | 782 | 500= |
| | KABANA 4H | 240 | 893 | 282 | 611 | 750= |
| | KABANA5 | 240 | 319 | 25 | 294 | 00= |
| | Pita 14 | 240 | 64 | 16 | 48 | 550= |
| | Pita 17 | 240 | 10 | 0 | 10 | 500= |
| | Mpologoma | 240 | 422 | 90 | 332 | 550= |
| | Kisansa | 240 | 346 | 102 | 244 | 516= |
| | Namaliga | 240 | 148 | 68 | 80 | 500= |
| | Musakala | 240 | 351 | 97 | 254 | 530= |
| | **Totals** | **2640** | **3,827** | **(613)** | **893** | **2,934** |
| Southern & Western highlands/Western Drylands | | | | | | |
| | KABANA 1H | | | | | |
| | KABANA 2H | 70 | 15 | 10 | 5 | 300 |
| | KABANA 3H | 70 | 292 | 205 | 87 | 600 |
| | KABANA 4H | 70 | 225 | 207 | 48 | 600 |
| | KABANA5 | 70 | 32 | 32 | 0 | 0 |
| | Mpologoma | 70 | 5 | 5 | 0 | 0 |
| | Musakala | 70 | 10 | 10 | 0 | 0 |
| | **Totals** | **420** | **579** | **(58)** | **469** | **140** |

Note: Figures in brackets are the number of farmer beneficiaries

## Discussion

Although the farmers noted that the introduced banana genotypes had less acceptable fruit qualities than the local cultivars, they appreciated their superior yield attributes. Most of the introduced genotypes were bred for resistance to pests and diseases, to which local cultivars are susceptible. This is in line with the observation that there is no 'perfect' variety, i.e., one that is resistant to all pests and diseases, yields high, is good to eat and handles well (Daniells, 2000).

On station results indicated that for any given purpose, at least three genotypes were rated 'acceptable'. Genotypes accepted for cooking were 'KABANA 1H', 'KABANA 4H' and 'KABANA 3H', those accepted for dessert were 'KABANA 3H', 'KABANA 4H' and 'KABANA 1H', while 'KABANA 2H', 'KABANA 1H' and 'KABANA 5' and were acceptable juice bananas

(Nowakunda, 2001). Although 'KABANA 1H' was accepted as a cooking, dessert and juice hybrid, the involvement of farmers at multilocational testing confirmed it was most suitable for cooking and dessert.

In the Kagera region of Tanzania, the same hybrid was acceptable for cooking, dessert, juice and roasting, though cooking and dessert were reported to be the most preferred uses (INIBAP, 1998).

The hybrids 'KABANA 3H' and 'KABANA 4H' were accepted both as cooking and dessert bananas on station, but the primary preference of these hybrids was either cooking or dessert, depending on the level of the highland banana (the traditional cooking bananas) productivity in the area (KARI, 1996)

The primary purpose of the hybrids in the North, North-East and Eastern parts of Uganda was cooking and dessert was secondary. This is because highland banana productivity in these areas is so low such that in its absence, traditional cooking banana eaters are more willing to eat 'KABANA 3H' and 'KABANA 4H' than cassava or sweet potatoes. Therefore, they are not ready to use their precious bunches for dessert but for 'food'. This is also true in Luwero District, where highland banana productivity has declined to its lowest in Uganda.

On the other hand, in districts where highland banana productivity has not completely declined the primary purpose of 'KABANA 3H' and 'KABANA 4H' is dessert and cooking is secondary. This is because farmers in these areas still have some highland bananas to use for 'food' and can therefore afford to eat 'KABANA 3H' and 'KABANA 4H' as dessert.

Roasting was a purpose that had not been considered on station. However, multilocational trials indicated that the most preferred use of 'TMPx 7002-1' and 'TMPx 7152-2' was roasting. In addition, the ripe fruits of these hybrids could also be 'cooked in skin' and eaten. The farmers noted that the most preferred use of the IITA hybrid 'TMPx 4479-1' was juice in all districts except Rakai (with almost extinct plantains/roasting bananas) where it was preferred for roasting (Table 4). Rakai is a district that has been severely hit by labour shortage in the past decade, caused by the AIDS scourge leading to considerable neglect of banana plantations and complete abandonment in some cases (FAO, 1993). Such mismanaged plantations suffer high weevil population build up to levels that can easily wipe out susceptible cultivars. Cultivars belonging to the plantain subgroup (AAB), which are the traditionally roasting type have been reported to be the most susceptible to banana weevil in Uganda (Kiggundu, 2000). Rakai district has been deficient in roasting banana types because of their disappearance due to the banana weevil. Thus although 'TMPx 4479-1' can be used for both juice and roasting, in Rakai it is preferred for roasting because of lack of roasting banana types in the district. Such differences in preferred uses could not be exhausted if farmers were not involved in multilocation testing. The determination of uses by researchers alone would limit the uses and eventually the adoption of the new genotypes.

The involvement of farmers in multilocational testing of genotypes resulted into several advantages. It reduced the time required to get promising genotypes to end-users. Traditionally, breeders conducted multilocational trials without involving farmers. Farmers would be involved during on-farm testing of promising genotypes, a process that used to take long for them to get promising germplasm. Since farmers were the main evaluators in the present study, they were responsible for maintaining the plantations, making it cheap for researchers. This in turn has an advantage of enabling researchers to carry out tests in several districts, catering for the different agro-ecological zones and farming systems. Farmers have already taken initiatives to multiply planting materials of preferred genotypes either for their own plantations or for sell.

This has been done on an individual basis, with assistance from Non-Governmental Organisations, women groups and church projects. In addition to expediting the dissemination process, this enables researchers to operate cheaply because they do not incur costs of multiplying planting materials, as would have been the case without involving farmers.

The system gave an opportunity to extension staff to get involved in the trials because they were supposed to assist farmers in the absence of the researchers. This enabled the extension staff to gain knowledge about the new bananas and enrich their knowledge about recommended banana management practices quite early such that by the time these materials are officially released, the extension staff is well versed with all the relevant information to advise other farmers. The involvement of farmers as the main evaluators also instilled in farmers a sense of ownership of the trials and in case of any problem, failure or short-coming farmers did not put the blame on researchers because farmers played big roles in decision making and in the selection process.

Although the system had several advantages, it had a few shortcomings. In some cases, farmers mismanaged the trials and in other cases they completely abandoned them. Data collection was not also efficiently done since some farmers did not take proper record of the required data. However, the advantages outweighed the disadvantages, and the procedure is recommended as a generally efficient evaluation and delivery system.

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