Spread of Cooking Bananas (*Musa* spp., genome ABB) in a Traditional Plantain-Growing Area in Southeast Nigeria

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Summary

The study examined the level and rate of spread of cooking bananas (Musa *spp., ABB genome) to determine their success among the farmers. They were introduced in Southeastern Nigeria in the mid-1980s by the International Institute of Tropical Agriculture (IITA) as an interim measure to reduce the incidence of black sigatoka disease on plantains. Data were collected, using a structured questionnaire, from 285 randomly selected farmers in 76 villages. Results of the study indicate that about 60% of the respondents have given out suckers to other fellow-farmers. On average, every "diffuser" distributed 8 cooking banana suckers to 5 new fellow-farmers. Primary and secondary diffusions accounted for 59% and 61% respectively; while inter-village diffusion accounted for about 50% of the movement of the suckers. The study also found that the demand for the crop has been increasing since its introduction in the region.*

These results indicate a high level of diffusion of the crop considering its newness in the region and that it is well accepted. They also suggest that the crop has the potential of supplementing plantain in food and income generation for the farmers in the region.

Résumé

Diffusion des bananes à cuire (*Musa spp*., génome ABB) dans une région productrice de plantains du sud-est du Nigeria

*Cette étude a examiné le niveau et le taux de diffusion des bananes à cuire (*Musa *spp., ABB génome) parmi les paysans du sud-est du Nigeria. Ces bananes avaient été introduites dans cette région au milieu des années 80' pour remédier aux effets néfastes de la cercosporiose noire sur la banane plantain. Deux cent quatre-vingt cinq paysans, sélectionnés au hasard dans 76 villages où les bananes à cuire avaient été distribuées, ont été questionnés pour réaliser la présente étude.*

Les résultats de l'étude révèlent qu'environ 60% de paysans interviewés ont donné des rejets à d'autres paysans. Un niveau très élevé de propagation des bananes à cuire malgré sa courte présence dans la région. En moyenne, chaque paysan a donné 8 rejets à environ 5 autres nouveaux paysans. Le pourcentage de diffusion primaire s'est élevé à 59% et celui de diffusion secondaire à 61%. Environ 50% de rejets échangés ont eu lieu entre paysans de villages différents. L'étude a aussi montré que la demande des rejets des bananes à cuire est en constante augmentation depuis leur introduction dans la région.

Ces résultats indiquent un niveau de diffusion très élevé malgré une introduction relativement récente dans la région. Ils suggèrent aussi que cette nouvelle culture a été bien acceptée et qu'elle a le pouvoir de suppléer le plantain dans la recherche du revenu agricole et de la sécurite alimentaire.

Introduction

In the mid-1980s, the International Institute of Tropical Agriculture (IITA) introduced cooking bananas (*Musa* spp*.*, ABB genome) into Southeast Nigeria from Asia (12). They were meant to serve as an interim measure in checking the incidence of black sigatoka disease on plantains. Black sigatoka is a fungal leaf spot disease (caused by the fungus *Mycosphaerella fijiensis* Morelet) that had become a serious threat to plantain production in sub-Saharan Africa (SSA) (9, 13), reducing yield by up to 50% (9, 7), and in some instances, leading to total crop failure. The long-term strategy consisted of the establishment of a plantain-breeding program aimed at conferring black sigatoka resistance characteristics to plantains.

The major cooking banana cultivars introduced were Cardaba, Bluggoe, Fougamou, Nzizi, and Pelipita (5). They all have an ABB genome constitution and, except for Bluggoe, they are resistant to black sigatoka disease. Cooking bananas also have other important attributes including lodging resistance, drought tolerance, early ratooning capacity, as well as high bunch yield (2, 4, 8). They are less seasonal in production and have the potential of surviving in areas

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where plantains and sweet bananas do not, due to their hardiness (8).

On introduction, cooking banana plantlets were multiplied by *in-vitro* techniques and distributed to farmers. However, since the introduction of the crop, no effort has been made to evaluate the success of the crop among the farmers. One of the ways of determining the success of an innovation is to assess the level and rate of its adoption as well as the rate at which such an innovation spreads among the target population/ area (3). Tshiunza *et al.* (11) found that about 58% of farmers have adopted the crop; but they did not investigate its spread among the population. An innovation can be adopted by people but still remains confined in the area where it has been introduced. A diffusion study is therefore indispensable to confirm the success of the crop in the region or otherwise. This study therefore examines the level and rate of spread of cooking bananas among the farmers in Southeastern Nigeria.

Methodology

Sampling and data collection procedures

The study was carried out in the major plantain-producing area of Nigeria (Southeast) where the crop was initially introduced through non-governmental organisations and national institutions. Non-governmental organisations included the Shell Petroleum Development Corporation, the Nigeria Agip Oil Company, the Anglican Diocese of Awka, and the International Institute of Tropical Agriculture; while national organisations included State Ministries of Agriculture and Agricultural Development Programmes.

Through the assistance of the above institutions about seven hundred villages where the crop was introduced were identified, and a random sample of 76 was chosen for the study. In each village, a certain number of cooking banana farmers was chosen, depending on the intensity of cooking banana cropping, i.e. the number of farmers growing the crop. By this process, 285 farmers were randomly selected and interviewed, and their fields visited.

A structured questionnaire was designed and used to collect data from the selected farmers. Data collected included the source of the initial suckers received by the farmer (disseminating institution or fellow-farmer), the condition of acquisition of suckers (free or purchased), whether the farmer has given out suckers or not, the number and village name of fellow farmers to whom suckers were given, as well as the number of suckers given out. Data collection lasted from April 1998 to February 1999.

Definition of cooking bananas diffusion

The diffusion of a new technology can be measured in several ways depending on the situation and the type of technology under investigation (3). In this study, three inter-related parameters are used to measure the diffusion process: the number of farmers who have given out cooking banana suckers, the number of suckers given out, as well as the number of farmers to whom suckers were given. The study also makes a distinction between “primary” and “secondary” diffusion, and between “intra-village” and “inter-village” diffusion. Primary diffusion is measured from farmers who received their initial suckers from the disseminating institution(s), while secondary diffusion is measured from farmers who got their initial suckers from fellow farmers. Intra-village diffusion is the spread of cooking bananas measured within a village, while inter-village diffusion is the spread of cooking bananas between villages.

Presentation of results

Distribution of suckers to farmers

Plantlets were produced in two tissue culture laboratories (Onne and Owerri) by *in vitro* techniques and given to disseminating institutions for distribution. The strategy adopted by all the institutions that took part in the distribution exercise was to establish of nurseries for the multiplication of suckers. This enabled them to generate enough material for distribution. They created awareness of cooking bananas through various media such as seminars/workshops, field demonstration days, contact farmers, farmer group co-operatives, extension staff visits, and announcements in churches. Extension staff visits were the most common means of informing farmers about cooking bananas. Depending on the disseminating institution, farmers were supplied with suckers or asked to collect these at the multiplication site. The distribution of suckers to farmers was chiefly carried out through farmers’ visits to the institutions. On average, about 4 suckers were supplied to each farmer by the disseminating institutions (Table 1).

Table 1

Amount of suckers initially distributed to farmers

Suckers (range)	Farmers	
	Frequency	Percentage
1 - 2	172.00	67.45
3 - 5	38.00	14.90
6 - 10	24.00	9.41
11 - 20	14.00	5.49
21 - 30	7.00	2.75
Mean= 3.88 (Std= 5.56)	255.00	100.00

In general, the quantity of suckers collected by each farmer depended on the amount of land the farmer had available, his closeness to the multiplication site, and the efficiency of the transportation system used by field extension staff. Cooking banana suckers were planted by farmers both in compound (nearby) and distant fields. At the time of survey, farmers had more suckers in nearby fields (average of 4.01 suckers) than in distant fields (average of 2.24 suckers) (Table 2).

This figure represents the level of primary diffusion in terms of cooking banana farmers, and is considered relatively high, considering the newness of the crop in the region. About 98% of suckers released by these farmers were directly given to fellow-farmers, while 2% were returned to disseminating institutions to supply to other farmers. Most disseminating institutions distributed suckers free of charge, but Shell and Agip adopted the option of requiring the farmer to return the same number of suckers after the first harvest.

Table 2

Average number of cooking banana mats owned (at the time of survey) by farmers in nearby and distant fields

Field location	Mean	Maximum	Minimum	Std	N
Nearby	4.01	25.00	0.00	4.60	255.00
Distant	2.24	30.00	0.00	4.89	255.00
Overall	6.25	48.00	0.00	7.21	255.00

Std= standard deviation; N= number of observations

Cardaba was the most common cultivar found, followed by Bluggoe. In most villages, local names were given. For instance, Cardaba was called “Four corners” in Rivers State (Tai Local Government), Mboro in Cross River State (Calabar Local Government), and Une in Imo State (Ohaji/Egbema and Oguta Local Governments).

Primary and secondary diffusion of cooking bananas

Results of analysis indicate that 58.88% of farmers who had received their initial suckers from disseminating institutions had given out suckers to other fellow-farmers (Table 3).

On average, every farmer supplied with suckers by disseminating institution(s) reached about 5 other fellow-farmers with the crop, which is a multiplication rate of cooking banana farmers of about 500%. Manyong *et al.* (6) reported a 228% multiplication rate among farmers 4 years after new soybean cultivars were introduced in Northern Nigeria.

About half of the suckers were exchanged in primary diffusion and the rest in secondary. On average, each primary diffuser had given out about 11 suckers to other fellow-farmers. Given that about 4 suckers were received from the disseminating institution(s), this result means that for one sucker received the primary diffuser has given out about 3 suckers (11 suckers

Table 3

Primary and secondary diffusion of cooking bananas in Southeast Nigeria

Diffusion parameter		Primary diffusion	Secondary diffusion	Overall
Percentage of farmers		58.88	60.59	59.93
who gave out suckers (“diffusers”)	N	107.00	170.00	277.00
Number of farmers reached		5.42	4.60	4.89
with the crop per “diffuser”	N	52.00	94.00	146.00
	Std	4.25	4.17	4.20
Percentage of suckers		51.98	48.02	100.00
given out (total = 1639)	N	58.00	99.00	157.00
Number of suckers		11.10	6.56	8.18
given out per “diffuser”	N	52.00	94.00	146.00
	Std	7.78	6.47	7.27

N= number of observations; Std= standard deviation

given away divided by 4 suckers received from the disseminating institutions), which is a multiplication rate of suckers of about 300%. This also means that each new fellow-farmer had received an average number of 2 suckers (11 suckers given out by each primary diffuser divided by 5 new cooking banana farmers).

Secondary diffusion results indicate that about 61% of the second set of farmers who had received suckers also gave out suckers to other fellow-farmers. This figure represents the level of secondary diffusion. On average, also every secondary diffuser reached about 5 new fellow-farmers, which is a multiplication rate of cooking banana farmers of about 500%. In terms of suckers, each secondary diffuser gave out about 7 suckers to other farmers. Given that every secondary diffuser had received 2 suckers from primary diffuser(s), this result means that for one sucker received the secondary diffuser gave out about 3.5 suckers (7 suckers divided by 2 suckers), which is a multiplication rate of suckers of about 350%. Since every secondary diffuser gave out about 7 suckers to 5 fellow-farmers, this means that every new fellow-farmer (beneficiary from the secondary diffusion) had received about 1.4 suckers (7 suckers divided by 5 new beneficiaries).

Overall, for one farmer supplied with suckers by disseminating institutions about 30 other fellow-farmers were reached with the crop, 5 in primary diffusion and 5 x 5 in secondary diffusion. In terms of suckers, for one sucker released by disseminating institutions, about 14 other suckers were generated (by the farmers) and distributed to other fellow-farmers, 3 in primary diffusion and 3.5 x 3 suckers in secondary diffusion. This is a clear indication that the crop has spread far and is well accepted and establishing itself among the farmers.

Intra- and inter- village diffusion of cooking bananas

The extent of spread can also be measured by examining the movement of the innovation over space. Farmers who got their suckers from fellow-farmers were asked to indicate whether the latter resided in the same village or not, and if not, to say where they lived. Results show that about half of the farmers received their initial suckers from fellow-farmers residing in different villages (inter-village diffusion) (Table 4).

In terms of sucker movement, up to 49% of the suckers exchanged in the region crossed village boundaries. The request for suckers from other villages (inter-village diffusion) is more evidence of the success and wide spread of cooking bananas in the region.

Rate of spread of cooking bananas over time

The annual diffusion rate of cooking banana farmers was obtained by dividing the total number of farmers to whom a particular farmer had given suckers by the number of years the farmer has been cropping the crop. Likewise, the annual diffusion rate of cooking banana suckers was obtained by dividing the number of suckers given out by a particular farmer by the number of years the farmer has been cropping the crop. On the average, the annual rate of diffusion is 2.53 for cooking banana suckers and 1.39 for cooking banana farmers (Table 5).

This means that every farmer has been giving out about two suckers to one farmer every year since he started growing the crop. Considering the relative “newness” of the crop in the region, the rate of spread is high. Also, the average number of farmers reached with the crop and that of suckers given away yearly have been increasing since its introduction. In other words, the demand for the crop has been increasing since its introduction in the region.

Discussion of the results

The level and rate of diffusion of cooking bananas among the farmers of the study area are considered relatively high given the short period since their introduction in the region. After four years of introduction of new soybean cultivars in Northern Nigeria, Manyong

Table 4

Intra- and inter-village diffusion of cooking bananas in Southeast Nigeria

Diffusion parameter	Intra-village	Inter-village	Overall
Percentage of farmers who received the crop from other farmers (total= 150)	50.00	50.00	100.00
Percentage of suckers received from other farmers (total of suckers= 329)	51.06	48.94	100.00

Table 5
Rate of diffusion of cooking bananas in Southeast Nigeria

Years of cropping cooking bananas	Number of suckers given away yearly per farmer	Number of farmers reached with the crop yearly per farmer	Number of observations
1 - 2	4.75	2.73	29.00
3 - 4	2.85	1.21	68.00
5 – 6	2.49	1.06	26.00
> = 7	1.87	1.07	31.00
Average= 4.49	2.53	1.39	154.00

et al. (6) reported a 228% multiplication rate among the farmers.

Among the factors likely to have affected this, are the attractive morphology of the crop, its high rate of sucker production, and its compatibility with the local plantain cropping and consumption systems. Morphologically, cooking bananas with their luxuriant leaves and firm-shiny stems are easily distinguished from plantains and sweet bananas. This attracts attention and interest, and thus the demand for the plant. Compared to local plantain cultivars, cooking bananas tend to produce more suckers; if not removed, they tend to overcrowd - and compete with - the main stem, which results in yield diminution. Upon introduction, farmers were therefore advised to reduce the number of suckers ("desuckering"). This easily contributed to the fast diffusion of the crop in the region. Farmers indicated that they easily and freely gave out suckers to other farmers since they always had enough. Again, because the material was given freely, other farmers were eager to acquire it. Apart from "desuckering", there is no special/specific attention required in cropping cooking bananas; farmers grow them just as they do for local plantains. In addition, no special recipe is needed to process cooking bananas for consumption. In another survey in the same region, Tshiunza *et al.* (10) found that cooking banana consumption patterns are similar to those of plantains.

The close-knit relationships as well as the extended family system that characterise the African rural system are likely to have also influenced the process of both intra- and inter-village diffusion of cooking bananas. Other factors likely to have affected the spread of cooking bananas between villages are relationships such as inter-village farming, inter-marriage and meetings, as well as the use of common markets.

Summary and recommendations

The study has shown that cooking bananas, which were introduced in Southeastern Nigeria as an interim measure in checking the incidence of black sigatoka disease on plantains, have spread so fast within a short period of introduction. Overall, for one farmer supplied with suckers by disseminating institutions at least 42 other farmers were reached with the crop. In terms of suckers, for one sucker released by disseminating institutions, at least 18 other suckers were generated (by the farmers) and distributed to other fellow farmers. This is a clear indication that the crop is well accepted and it is establishing itself among the farmers. This impressive spread also means that the crop has the potential of supplementing plantains in food and income generation for the farmers in the region. Since farmers have almost been responsible for the spread of the crop in the region, the introduction of "*Musa* innovations" should be targeted to farmers who are easily accessible to others, and who enjoy wide acceptability. This implies that the identification of the right audience is essential for the spread of the innovation to the target group. Future breeding efforts for hybrid plantains should consider breeding for cultivars that produce enough suckers, provided the farmers are taught the practice of removing excess suckers. Also, the incorporation of easily observable physiological traits into new hybrids is essential to facilitate awareness and spread. When villages are being selected for the introduction of an innovation, their relationships with nearby villages should be also considered as important. Easy access and close interactions greatly influence the chances of inter-village spread.

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