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On-Farm Evaluation and Consumer Acceptability Study of Selected Tetraploid *Musa* Hybrid in Ghana

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Abstract: An agronomic study was conducted to evaluate three *Musa* hybrids (BITA-3 - cooking banana, FHIA-21 and CRBP-39- both hybrid plantains) with five hundred farmers in the two Assin districts in the Central region of Ghana. At harvest sensory evaluation was carried out on the three hybrids for use as *fufu*, *ampesi* and ripe fried plantain to access their acceptability at four locations in the two districts. The results showed that there was no significant difference ($p<0.05$) between the numbers of leaves at flowering among the hybrids across the locations. The hybrids showed superiority over the local check in terms of number of functional leaves from flowering to harvest. All the hybrids (FHIA-21, CRBP 39, BITA-3 and FHIA-25) exhibited stable performance in yield and growth characteristics across the locations. FHIA-25 was however late maturing (18-20 months) whereas BITA-3 was early maturing (10-12 months). Nevertheless, the bunch weight (40-50 kg) of FHIA-25 could be said to have compensated for the long crop cycle. Daughter sucker production by FHIA-25 was also low (two daughter suckers at flowering). BITA-3 was roboust and sturdy with pseudostem girth of 60 cm carrying an average bunch weight of 25 kg. All the hybrids were resistant to the black Sigatoka disease. These results suggested that the performance of the hybrids was not influenced by the seasons or locations. It implies that under good management practices, farmers would be assured of good yields irrespective of time or season of planting so long as there is adequate supply of moisture. The results of the sensory evaluation indicated that there were no significant differences ($p<0.01$) between FHIA-21 and CRBP-39 and the local Apantu across the location, across the parameters and the recipes assessed. FHIA-21 and CRBP-39 were the most preferred and compared favourably with the local triploids (Apantu and Apem) with BITA-3 the least preferred. The hybrids were accepted for ripe fried plantain at stages 3 and 4 of ripening. Beyond these stages of ripening, the hybrids could only be used for other processed food recipes.

Key words: Musa hybrids, agronomy, sensory evaluation

INTRODUCTION

Plantain cultivation is of great socioeconomic importance in Ghana from the view point of food security and job creation. Plantain and banana (*Musa* spp.) are very important starchy staples in Ghana as well as in entire West African sub-region (Stover and Simmonds, 1987). They are consumed

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both as energy yielding food and as dessert. Plantain contributes about 13.1 per cent of the Agricultural Gross Domestic product and its per capita annual consumption of 101.8 kg per head (FAO, 2005) is higher than maize and yam except for cassava. Plantain and banana are also very important sources of rural income (Ortiz and Vuylsteke, 1996). Millions of farm households in Ghana produce plantains and bananas in backyard gardens, in mixed field cropping, in association with trees and also in intensive monocropping (Bioversity, 2007).

Yield losses in plantain production due to the disease are highly significant ranging from 20 to 50%. Under very severe conditions yield losses may be as high as 80%. The causes of low plantain yield can be classified as soil-related, biological (diseases and pests) and climatic. The major diseases and pests affecting production include nematodes, banana weevils, fungal disease Black Sigatoka (*Mycosphaerella fijiensis*), (IITA, 1992; Stover and Simmonds, 1987; Swennen, 1990). These pests and diseases can be controlled with appropriate chemicals but the cost is prohibitive. Furthermore, these chemicals are not environmentally friendly and thus threaten the fragile ecosystem. Consequently, the best viable alternative for the control is through the use of high yielding resistant hybrids. International research centres have succeeded in their breeding programmes. New hybrids, resistant/tolerant to these pests especially Black Sigatoka diseases have been developed by Honduran Agricultural Foundation (FHIA). Honduras, International Institute for Tropical Agriculture (IITA), Nigeria and African Research Centre for banana and plantain (CARBAP), Cameroun and have been introduced into Ghana for evaluation.

Plantain is relatively high in calories at 125 per cup. One cup cooked plantain yields a trace of fat, 2.3 g dietary fiber, 465 mg potassium, 26 mcg folate, 10.9 mg vitamin C, 909 IU vitamin A, 32 mg magnesium and 31.1 g carbohydrates (http://sarasota.extension.ufl.edu/FCS/FlaFoodFare/ Plantain.htm) Accessed on June 13, 2007). Plantains are known to be a great source of calcium, vitamins A, B_1, B_2, B_3, B_6, C and minerals such as potassium and phosphorous. Ripe mashed plantain is an excellent food for babies after the six month exclusive breast feeding. This advantage is due to the easy digestibility and the mineral and vitamin content. For elderly people, the fruit can be consumed in large quantities without being fattening or causing digestive disturbances (http://www.turbana.com/index.htm, Accessed August 14, 2003).

Plantain is known to be low in sodium (Chandler, 1995). It contains very little fat and no cholesterol; therefore it is useful in managing patients with high blood pressure and heart disease. They are free from substances that give rise to uric acid therefore, they are ideal for patients with gout or arthritis. Due to the low sodium and protein content, plantain is used in special diets for kidney disease sufferers. The capacity of the plantain to neutralize free hydrochloric acid suggests its use in peptic ulcer therapy (http://www.turbana.com/index.htm, Accessed August 14, 2003).

Plantains can be fried, boiled, mashed, stuffed and used for stuffing, baked, pickled and grilled. Green plantains are very hard and starchy; they have little banana flavor and no sweetness. They may also be boiled or fried or added to soups and stews. Yellow-ripe plantains are tenderer, but can be used in these same ways and will have a creamier texture. They can also be mashed, grilled, or baked. Black-ripe plantains are also delicious prepared in any of these methods but have a sweeter flavor and a banana aroma (http://www.truestarhealth.com/Notes/3616008.html (Accessed on June 13, 2007).

A fully ripe plantain mixed with milk powder is especially recommended for ulcer patients. For patients with gastritis and gastro-enteritis, banana is one of the first foods to be introduced after nausea and vomiting are brought under control. The low lipid/high palatability combination is ideal for the diet of obese people (http://www.turbana.com/index.htm, Accessed August 14, 2003). The plantain plant has also some medical properties. The leaves can be pounded and applied to the wound to suppress bleeding.

As a long term solution to address these problems in Ghana, new hybrids, resistant/tolerant to these pests and diseases have been introduced for their agronomic performance and consumer acceptability. This study was therefore conducted to evaluate the hybrids on-farm and assess their food qualities and consumer acceptability.

MATERIALS AND METHODS

A study was conducted in the two Assin districts of the Central region of Ghana. The districts are within longitudes 1°05′ and 1°25′ West and latitudes 6°.05′ and 6°.40′ North with a bimodal annual rainfall between 1500 and 2000 mm. The Assin soils are red-brown and clay-rich (Nitrosols).

Tissue culture plantlets of FHIA-21, CRBP 39, BITA-3 and FHIA-25 were received from Du Roi laboratory in South Africa in April 2003. Plantlets were weaned at the Crops Research Institute, Kumasi and distribution to farmers. A total of five hundred farmers from ten communities in the two Assin districts were involved. The trials were established in June 2003. Each farmer received eight planting materials of each variety. However, in each community, the fifty farmers organized themselves into groups of four or six farmers. Each group therefore pooled materials together to form a plot thus representing a replicate. In effect, there were eight or more plots in each community. With the help of agricultural extension agents, farmers planted the materials alongside any landrace of their choice. The most common landrace used by the farmer groups was *Apantu* (False Horn). Farmers were allowed to use their traditional agronomic practices. However no soil amendment was applied. Plant spacing of 3×2 m was used giving a plant population of 1667 plants ha^{-1}. Each group of farmers had a minimum of 128 plants per plot. Farmers were trained on rapid multiplication of healthy planting materials, farm hygiene and other agronomic practices that could reduce pest and disease incidence on their farms. Data was collected from three plots per community for five locations. Agronomic data collected included: plant height at flowering and at harvest, pseudostem girth (one metre above ground) at harvest, number of leaves at flowering and at harvest, number of months to flowering and to harvest, bunch weight, number of hands per bunch, number of fingers and the number of lodged plants per plot. The black Sigatoka disease evaluation was done using the Stover scale of 1 to 10 (1 as very low and 10 as very severe disease incidence (Stover and Simmonds, 1987) as observed on the 3rd leaf. A post project appraisal was conducted to assess the performance of the varieties. Individual interviews and semi-structured questionnaires were used. An average of 4 farmers were interviewed per community while in a few communities where the turn out was high (up to 77 farmers) focus group discussions was organised. Data was analyzed using ANOVA.

Consumer Acceptability Study

Physiologically matured unripe bunches of the hybrids, FHIA-21, BITA-3, CRBP-39 and standard cultivars, Apantu and Apem were harvested from some participating farmers' fields in the districts and transported to four communities (Assin Foso, Adiembra and Bremang in the Assin North and Amoaning in the Assin South). The samples were given to a local food vendor each at the two locations to prepare *ampesi* and *fufu*. *Apem* was used to prepare *ampesi* while *Apantu* was used to prepare *fufu*. Four separate consumer acceptability tests were held in Assin Fosu, Adiembra, Bremang and Amoaning. At Assin Foso, 60 panelists selected from various governmental departments, plantain farmers and plantain sellers. At Adiembra, 110 people participated whereas at Bremang 100 people took part in the sensory evaluation. At Amoaning, 90 farmers and plantain sellers from six surrounding communities participated.

The local dishes prepared were:

Table 1: Hedonic scoring for the assessment of consumer acceptability of unripe plantain

Scale	Texture	Taste	Colour	Poundability	Overall acceptability
1	Too hard	Excellent	Excellent	Too hard	Excellent
2	Very hard	Very acceptable	Like very much	Very hard	Very good
3	Good	Good	Good	Easy to pound	Good
4	Fair	Fair	Fair	Fair	Fair
5	Poor	Poor	Poor	Poor	Poor

Ampesi is prepared by boiling the pulp of green fruits. As the firmness of the raw pulp of introduced accessions was low, the fruits were boiled for between 10 and 15 min only whereas the local cultivar, *Apem*, with very firm pulp was cooked for 30 min. The *Ampesi* was offered to the panelist with a vegetable sauce

Fufu is prepared by boiling the pulp of green fruits and cassava. In this case, the pulp of the hybrids were taken off the fire 15 min after boiling while the cassava and the pulp of *Apantu* remained boiling for 30 min. The cassava and the plantain pulp were pounded into a paste and eaten with soup, fish, chicken and meat. The *fufu* was offered to the panelists with soup.

Fried Ripe Plantain

The ripe fruits were peeled and sliced transversely of about two centimeter thickness. The slices were dipped into salty water and fried in vegetable oil.

Sensory Evaluation

Untrained taste panelists from four communities Assin Foso, Adiembra, Bremang and Amoanin all in the Assin districts of the Central region of Ghana comprising both and females were used in the study. Assessors were not selected or trained to produce a panel showing definite preference but rather one which consistently reflected the range of preferences likely to be typical of Ghanaian consumers. At each time, panelists were presented with two coded samples (A and B) of *fufu* and *ampesi* comprising of *Apantu*, *Apem* and *Musa* hybrids, FHIA-21, BITA-3 and CRBP-39. Assessors were asked to compare the two coded samples on the bases of texture, taste, colour and overall acceptability, using the hedonic descriptive scale of 1-5 (Table 1). In addition, panelists were asked to state which of the two samples they preferred most. All assessors were instructed in basic taste panel procedures: to make their own individual judgments after a moderate amount of consideration. They were instructed to take a sip of water and pause briefly before tasting each sample and to re-taste if they are not sure of their decisions. The data was analysed using Analysis of Variance (ANOVA).

RESULTS AND DISCUSSION

The total number of functional leaves that a plant has at flowering time is a good indicator of its tolerance or susceptibility to pests and diseases, with correlation existing between number of leaves and bunch weight (Alvarez, 1997). There was no significant difference ($p<0.005$) between the numbers of leaves at flowering among the hybrids across the locations (Table 2). The local check however had a drastic reduction in functional leaves from flowering to harvest (Table 3). The hybrids presented very vigorous plants with stronger and more erect pseudostems which allowed them to support heavier bunches and to resist the effect of the wind. The use of healthy planting materials coupled with adoption of improved agronomic practices that encourage vigorous crop growth leads to less attack and losses caused by the banana pests (Seshu Reddy *et al*., 2000). In a study it was found that black Sigatoka disease could reduce pseudostem girth at the crown region by 50-86% (Padmanaban *et al*., 2001). A study reported that there was a correlation between plant girth and

Table 2: Number of functional leaves of selected *Musa* accessions at the time of flowering

	Number of functional leaves per location				
Varieties	Wurakese	Kenia	Adiembra	Dorsi	Jakai
FHIA-21	14.0	14.0	14.0	14.0	13.0
CRBP-39	14.0	13.0	13.0	12.0	11.0
BITA-3	14.0	13.0	14.0	14.0	13.0
FHIA-25	15.0	15.0	14.0	14.0	14.0
Apantu	12.0	11.0	12.0	10.0	11.0
LSD	1.2	1.3	1.2	0.9	1.0
Cv (%)	1.2	2.5	1.8	2.2	2.1

Table 3: Number of functional leaves of *Musa* accessions at the time of harvest

	Number of functional leaves per location				
Varieties	Wurakese	Kenia	Adiembra	Dorsi	Jakai
FHIA-21	9.0	9.0	9.0	8.0	8.0
CRBP-39	7.0	6.0	7.0	6.0	8.0
BITA-3	9.0	9.0	9.0	8.0	8.0
FHIA-25	9.0	9.0	9.0	9.0	9.0
Apantu	4.0	4.0	4.0	4.0	4.0
LSD	1.6	1.9	1.6	1.7	1.8

Table 4: Yield and selected agronomic parameters of accessions at harvest at Assin-Wurakese

Varieties	Plant height (cm)	Plant girth (cm)	Months to harvest	Yield (kg)	Hands/ bunch	Finger/ bunch	BSD (%)
FHIA-21	258.0	52.0	14.0	24.0	8.0	89.0	0
CRBP-39	273.0	47.0	14.0	18.0	7.0	61.0	0
BITA-3	274.0	49.0	11.0	23.0	6.0	64.0	0
FHIA-25	221.0	60.0	18.0	31.0	13.0	186.0	0
Apantu	290.0	48.0	14.0	12.0	5.0	38.0	6
LSD	4.6	2.3	3.4	6.4	9.6	10.2	
CV (%)	16.0	1.2	4.2	6.0	16.0	11.0	

Table 5: Yield and selected agronomic parameters of accessions at harvest at Assin-Kenia

Varieties	Plant height (cm)	Plant girth (cm)	Months to harvest	Yield (kg)	Hands/ bunch	Finger/ bunch	BSD (%)
FHIA-21	245.0	55.0	14.0	30.0	9.0	92.0	0
CRBP-39	283.0	46.0	14.0	21.0	6.0	62.0	0
BITA-3	267.0	57.0	11.0	25.0	7.0	67.0	0
FHIA-25	242.0	62.0	18.0	35.0	14.0	195.0	0
Apantu	270.0	48.0	14.0	12.0	5.0	37.0	6
LSD	6.2	3.3	4.1	5.2	4.2	5.6	
CV (%)	12.0	6.0	5.1	6.0	15.0	21.0	

Table 6: Yield and selected agronomic parameters of accessions at harvest at Assin-Adiembra

Varieties	Plant height (cm)	Plant girth (cm)	Months to harvest	Yield (kg)	Hands/ bunch	Finger/ bunch	BSD (%)
FHIA-21	255.0	50.0	14.0	27.0	9.0	86.0	0
CRBP-39	280.0	43.0	14.0	12.0	7.0	67.0	0
BITA-3	294.0	48.0	11.0	22.0	7.0	62.0	0
FHIA-25	245.0	65.0	18.0	35.0	13.0	179.0	0
Apantu	269.0	52.0	14.0	11.0	5.0	43.0	6
LSD	4.3	2.1	4.1	5.2	4.2	5.4	
CV (%)	20.0	5.0	5.0	5.5	8.0	18.0	

infestation of weevils (Dutti and Maiti, 1972). However other studies indicated that there was no relation between infestations, stem girth and plant height.

All the hybrids (FHIA-21, CRBP 39, BITA-3 and FHIA-25) exhibited stable performance in yield and growth characteristics at the locations (Table 4-8). FHIA-25 was late maturing (18-20 months) whereas BITA-3 was early maturing (10-12 months) compared to the others. However

Table 7: Yield and selected agronomic parameters of accessions at harvest at Assin-Dorsi

Varieties	Plant height (cm)	Plant girth (cm)	Months to harvest	Yield (kg)	Hands/ bunch	Finger/ bunch	BSD (%)
FHIA-21	260.0	52.0	13.0	28.0	9.0	89.0	0
CRBP-39	265.0	46.0	14.0	16.0	7.0	62.0	0
BITA-3	280.0	55.0	12.0	23.0	7.0	60.0	0
FHIA-25	240.0	65.0	18.0	31.0	14.0	201.0	0
Apantu	270.0	52.0	14.0	9.5	5.0	42.0	6
LSD	3.4	3.0	3.1	4.8	5.0	6.4	
CV (%)	16.0	6.0	5.0	6.2	4.0	6.2	

Table 8: Yield and selected agronomic parameters of accessions at harvest at Assin-Jakai

Varieties	Plant height (cm)	Plant girth (cm)	Months to harvest	Yield (kg)	Hands/ bunch	Finger/ bunch	BSD (%)
FHIA-21	255.0	55.0	13.0	28.0	9.0	89.0	0
CRBP-39	280.0	46.0	14.0	16.1	7.0	62.0	0
BITA-3	294.0	55.0	11.0	23.0	7.0	60.0	0
FHIA-25	255.0	60.0	19.0	30.9	14.0	201.0	0
Apantu	265.0	50.0	14.0	14.0	5.0	42.0	6
LSD	3.6	3.2	3.0	5.0	4.8	6.0	
CV (%)	14.0	5.8	6.0	6.6	4.5	6.7	

Table 9: Comparative sensory evaluation of selected hybrids evaluated for *fufu* at four locations in the Assin districts

Hybrid/cultivar	Texture	Taste	Flavour	Colour	Poundability	Overall acceptance
FHIA-21	4.24a	4.24a	4.24a	4.24a	4.01a	4.67a
BITA-3	2.98	2.62	2.01	2.01	2.67	3.02
CRBP-39	3.43b	3.98b	3.23	3.89b	3.06b	4.32a
Apantu	4.24a	4.24a	4.32a	4.24a	4.01a	4.67a

Letters in common within columns were not significantly different at the 1% level

the bunch weight (40-50 kg) of FHIA-25 may be described as commensurate with the crop cycle. The pseudostem girth (65 cm) of FHIA-25 coupled with the shorter height (235 cm) was enough to carry the huge bunch. Daughter sucker production by FHIA-25 on the other hand was low (two daughter suckers at flowering). BITA-3 was roboust and sturdy with pseudostem girth of 60 cm carrying an average bunch weight of 25 kg. All the hybrids were also resistant to the black Sigatoka disease. These results suggested that the performance of the hybrids was not influenced by the seasons or locations. It implies that under good management practices, farmers would be assured of good yields irrespective of time or season of planting so long as there is adequate supply of moisture.

Consumer Acceptability

The results showed there was no significant difference ($p>0.01$) between *fufu* (pounded plantain with cassava) from FHIA-21 and CRBP-39 and that of the local Apantu (Table 9). BITA-3 though was less preferred for its softness was accepted for use in the preparation of fufu (Table 9). BITA-3 is as a cooking banana and thus has high characteristic of banana than plantain. FHIA-21 though resembles the triploid French plantain could be used for fufu. The taste, flavour, colour and poundability of FHIA-21 compared favourably with the local triploid Apantu.

There was no significant difference between *ampesi* (boiled green sliced plantain) of FHIA 21 and CRBP 39 in terms of tasted, texture, flavour and colour and the *Apem*.(local French plantain) (Table 10). The triploid French plantain when boiled green is crunchy whereas the tetraploids become slightly soft when boiled green. It was the *ampesi* of the BITA 3 which was a bit soft and was less preferred. It was observed that all the hybrids required less time for boiling. BITA-3 taste better as *ampesi* when boiled for about 10 min and allowed to cool before eaten. It is significant to mention that, cooked samples of FHIA-21 and CRBP 39 tasted similar to Apantu and Apem. The attractive pulp colour of cooked FHIA-21 and CRBP 39 was similar to that of Apem. It came to light that the hybrids do not boil for long before cooked. Work by other researchers indicated that loss of firmness or

Table 10: Comparative sensory evaluation of selected hybrids evaluated for *ampesi* at four locations in the Assin districts

Hybrid/cultivar	Texture	Taste	Flavour	Colour	Overall acceptance
FHIA-21	4.32a	4.56a	4.48a	4.54a	4.54
BITA-3	3.89	3.67	2.81	2.98	2.45
CRBP-39	4.12a	4.16a	4.32a	4.28a	4.28
Apem	4.32a	4.56a	4.48a	4.86a	4.89

Letters in common within columns were not significantly different at the 1% level

Table 11: Comparative sensory evaluation of selected hybrids evaluated for fried ripe plantain at four locations in the Assin districts

Hybrid/cultivar	Texture	Taste	Colour	Sweetness	Overall acceptance
FHIA-21	4.12a	4.71a	4.45a	4.26a	4.71a
BITA-3	2.32	3.67	2.18	3.12	3.67
CRBP-39	4.12a	4.61a	4.36a	4.12a	4.61a
Apantu	4.62a	4.78a	4.67a	4.78a	4.78a

Letters in common within columns were not significantly different at the 1% level

softness in fruits as a result of cooking or heating, involves the loss of turgor, a series of chemical changes in the cell matrix polysaccharides and the swelling and gelatinization of starch (http://food.oregonstate.edu/starch/starch_lec2.html accessed on January 8, 2008)

All the hybrids were accepted when processed into ripe fried at ripening stages 3 and 4. FHIA-21 and CRBP 39 were highly preferred and BITA-3 less preferred (Table 11). Taste was a key characteristic that determined the acceptability of the hybrid. The results compared favourably with a similar study by Dzomeku *et al*. (2006) and Dadzie (1998).

In most countries in West and Central Africa where green plantains are consumed as a major part of the meal, the predominant method of cooking matured green unripe plantains include, boiling or steaming and served as a cooked vegetable with stew or sauce. Sometimes, the green plantain is roasted or baked and frequently the green plantain is also pounded after cooking into a paste or dough, often in combination with cassava (called *fufu*) and served with soups, sauces and meat or fish. Because of the varying methods of cooking and uses of plantains, the texture, particularly, the softness of the cooked plantain is very important in determining a good cooking plantain cultivar. The choice of a plantain cultivar for particular method of cooking or processing is therefore probably based largely on the textural properties of the tissues after cooking. Consumers often prefer plantain cultivars that have good textural qualities after cooking and should suit the various uses. BITA-3 became very soft after cooking compared to FHIA-21 and CRBP 39. However, all the hybrids were accepted for processing into ripe fried plantain. Some panelists who claimed to be diabetic however indicated their preference for BITA-3 as their sugar level was normal after eating any form of food from BITA-3. This could be attributed to the high banana characteristic in the hybrid thus low carbohydrate content.

CONCLUSION

These results suggested that performance of the hybrids was not influenced by locations. They were all agronomically stable, high-yielding and black Sigatoka resistant. It implies that under good management practices, farmers would be assured of good yields irrespective of time or season of planting so long as there is adequate supply of moisture. The study also showed that FHIA-21 and CRBP 39 compared favourably with Apantu at the four locations both for *fufu*, *ampesi* and fried ripe plantain. The cooking banana was preferred in the processed forms than in the raw state. In the introduction of new *Musa* hybrids to farmers, the food habits of the people must be considered.

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REFERENCES

Alvarez, J.M., 1997. Introduction, evaluation, multiplication and dissemination of FHIA hybrids in Cuba. INFOMUSA., 6 (2): 10-13.

Bioversity, 2007. Sustainable Production. http://bananas.bioversityinternational.org/content/view/67/97/lang,fr/ (Accessed on May 7, 2007). (http://sarasota.extension.ufl.edu/FCS/FlaFoodFare/Plantain.htm) Accessed on June 13, 2007).

Chandler, S., 1995. The Nutritional Value of Bananas. In: Bananas and Plantains, Gowen, S. (Ed.). Chapman and Hall.

Dadzie, B.K., 1998. Post-Harvest characteristics of black Sigatoka resistant banana, cooking banana and plantain hybrids. Inibap Technical Guidelines, pp: 75.

Dutti, N. and B.B. Maiti, 1972. Occurrence of non-sex limited variations in conspecific sympatric phena of *Odoiporus longicollis* (Oliv). Sci. Cult., 37: 572-574.

Dzomeku, B.M., M. Osei-Owusu, A.A. Ankomah, E. Akyeampong and S.K. Darkey, 2006. Sensory evaluation of some cooking bananas in Ghana. J. Applied Sci., 6 (4): 835-837.

FAO., 2005 (Food and Agriculture Organization). Food and agriculture indicators ESSA October 2005. http://www.fao.org/es/ess/top/country.html (Accessed on August 25, 2006).

IITA (International Institute of Tropical Agriculture), 1992. Sustainable food production in Sub-Saharan Africa, 1. IITA, Ibadan, Nigeria, pp: 208.

Ortiz, R. and D. Vuylsteke, 1996. Improving Plantain and Banana-Based System. In: Plantain and Banana Production and Research in West and Central Africa, Ortiz, R. and M.O. Akoroda (Eds.). Proceedings of a Regional Workshop 23-27 September, 1995.

Padmanaban, B., P. Sundararaju, K.C. Velayudhan and S. Sathiamoorthy, 2001. Evaluation of Musa germplasm against banana weevil borers. INFOMUSA., 10 (1): 26-28.

Seshu Reddy, K.V., L. Ngode, J.W. Ssenyonga, M. Wabule, M. Onyango, T.O. Adede and S. Ngoze, 2000. Management of pest and diseases of banana in Kenya: A status report. Review of IPM Research Activities-Case Studies, pp: 215-223.

Stover, R.H. and N.W. Simmonds, 1987. Banana. 3rd Edn. John Wiley and Sons, Inc. New York, pp: 468.

Swennen, R., 1990. Plantain Cultivation under West African Conditions: A Reference Manual. International Institute for Tropical Agriculture, Ibadan, Nigeria, Amarin Printing Group Co. Ltd. Thailand, pp: 24.