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Tea (Camellia Sinensis) Breeding in Nigeria: Past and Present Status

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Abstract- The understanding of the genetic resource status of an economic and medicinal crop such as tea (*Camellia simensis*) is a very relevant prerequisite for its improvement and advancing its research attention. This review summarises the available information on tea breeding in Nigeria. Tea cultivation in Nigeria contributes significantly to the economic development of the tea growing communities especially women who are about 75% in the tea industry. The available information showed that 2045 tonnes, 2914 tonnes made tea were produced in 2006 and 2007 respectively. The major breeding achievement was the adaptability of three tea clones to the lowland regions in Nigeria, standardization of pluck quality, the grouping of tea clones into three distinct groups for further hybridization studies. Induction of callus from tea stem cuttings, shoot apices and flower buds were not left out. Germplasm collection, introduction, hybridization and introduction of biotechnology techniques become urgent steps for tea improvement in Nigeria.

Index Terms- Tea breading, hybridization, plant biotechnology

I. INTRODUCTION

Tea *(Camellia sinensis*) is one of the most popular beverages and an important revenue source for the tea producing countries in the world. Tea is an evergreen, perennial, cross pollinated plant and grow naturally as tall as 15m but 60-100cm under cultivation with life span of more than 100 years. It is widely cultivated in countries of Asia (India, China, Sri lanka, Japan, Vietnam and Indonesia) and Africa (Kenya, Nigeria, Uganda and Malawi). Tea is the most popular drinks in the world in terms of consumption. Its consumption equals all other manufactured drinks in the world including coffee, chocolate, soft drinks and alcohol put together.

The amount of tea valuable chemicals found in tea is over 700 and most of them that are germane to with human health are flavanoides, amino acids, vitamins (C, E and K), caffeine and polysaccharides Mondel *et al*., (2007). However, green tea has been known for its effectiveness on diseases such as high blood pressure and high blood sugar. The antioxidants present in the tea together with other health related properties help in boosting memory, lowering body weight and preventing stroke. Punch July 6, (2013). Tea is good for cell-mediated immune function of the body. The beneficial role of tea to intestinal microflora is well proven and it provides immunity against intestinal disorders. It protects cell membranes from oxidative damage. Tea is well known for it effectiveness in preventing dental caries due to the presence of fluorine. Tea also contains germicidal and germistatic properties against various gram-positive and gram negative human pathogenic bacteria. Both green and black tea infusions contain numerous of antioxidants, viz-avis catechins that have anti-carcinogenic, anti-mutagenic and anti-tumoric properties. Mondel *et al*., (2007). In 2010, researchers found that people who consumed tea had significantly less cognitive decline than non-tea drinkers. The study used data on more than 4,800 men and women aged 65 and older to examine change in cognitive function over time. Study participants were followed for up to 14 years for naturally-occurring cognitive decline. Alzhemer's association (2010). The three major cultivars of tea throughout the world that have contributed to tea genetic pool are: China [*Camellia sinensis* (L.) O. Kuntze], Assam [*Camellia assamica* (Masters)] and Cambod [*Camellia assamica* sp. *lasiocalyx* (Planch. MS)] (Wight, 1962). Phenotypic diversity in tea is significantly high. The variation in the morphological, physiological and biochemical characteristics of the crop can be explained by the out-crossing nature of tea breeding method. Clonal selection is a good and widely developed method of tea plant improvement as a result of wide variation in the existing seedling population. (Barua, 2008). In 2003, the world tea production was estimated as 3.21 million tonnes annually while in 2008 the production of tea increased to 4.73 million tonnes. China, India, Kenya and Sri Lanka are the largest tea producers in the world respectively (FAO 2010).

II. TEA PRODUCTION IN NIGERIA

Tea *Camellia sinensis* (L.) O. Kuntze was introduced to Nigeria from Kenya in 1972 by Nigerian Beverage Production Company (NBPC). Ten years later tea breeding started with acquisition of 33 clones by Cocoa Research Institute of Nigeria from NBPC. Currently, tea is only growing in Mambilla plateau on an average of 950 ha. Efforts have so far been made to adapt tea to lowland areas of Nigeria viz-avis Ibadan (Oyo State), Ikom (Cross River Estate), Ikorodu (Lagos State) and Mayo-Selbe in (Taraba State) where clones 143, 318, 236 and 357 are promising. Generation of tea planting materials in-vitro through tissue culture was seriously explored. Information regarding the hybridization of tea is limited. However, vegetative means of propagating tea and selection pressure for high yielding clones have posed serious problem for genetic erosion which may lead to loss of valuable genetic traits. There is no information whatsoever, on the improvement of tea at DNA level in Nigerian tea germplasm. Therefore, there is urgent need for germplasm

collection both local and world leading tea clones, hybridization and tea improvement at molecular level in Nigeria.

Tea is important in the national economies of some African countries such as Cameroon, Kenya, Malawi and Tanzania (Omolaja S.S. and Esan E.B. (2005). Conversely in Nigeria the production has not been sufficient to meet up the demand from processing companies in Nigeria. However, tea production can contribute immensely to food security and poverty alleviation in Nigeria if much attention is given to improvement.

Fig: 1 Map of Nigeria showed Mambilla plateau in Taraba state were tea is growing

Table 1: Trend of tea production between 2006 to 2008 among 3 tea leading producing countries and Nigeria in tonnes

Country	2006	2007	2008
China	1,047,345	1,183,002	1,257,384
India	9,280,000	949,220	805,180
Kenya	310,580	369,600	345,800
Nigeria	2,045	2,914	-

Table 2: List of the tea clones in the germplasm

Serial number	**Clone number**
1	357
2	25
3	138
4	368
5	353
6	143
7	14
8	238
9	359
10	33
11	108
12	370
13	19
14	74
15	363
16	369
17	228
18	354
19	35
20	367
21	68
22	236
23	237

Table 1 above showed the results of tea production in three consecutive years among four tea producing countries of the world. China was the highest tea producer in all the years considered followed by India. Kenya becomes the highest producer of tea in Africa. However, the amount of tea produced in Nigeria is of no significance in the International market but there are potentials for Nigeria to improve her productivities. Tea is only grown commercially on the top of Mambilla plateau covering less than 1% of Nigerian land mass. Figure 1 above shows the area were tea is currently produced in Nigeria.

III. Clones

Clones are genetically uniform and give uniform yield and quality. The drawbacks of mass vegetative multiplication are yield variability under stress conditions and relative proneness to pathogens, whereas seed populations which have high genetic variability are less prone to stress condition and of average quality (Bandyopadhyay and Das, 2008). However, reliance on a limited number of clones may lead to a loss of valuable genetic resources (diversity) and an increase in potential risks of natural hazards like pests and diseases. So, wide genetic variability is desirable because it provides a buffer against co-evolving factors of natural hazards like diseases, pests and changing environment (Barua, 1963; Wachira *et al*., 1995). Investigation of genetic diversity of natural, old seedling tea populations in Nigeria is required to preserve these diverse populations as *in situ* conservation sites, prior to replace them with genetically more similar modern tea cultivars. Genetic variability with trait related molecular markers, genetic linkage maps with association mapping is urgently necessary to improve tea production in Nigeria.

IV. Breeding efforts on Tea in Nigeria

The scope of Cocoa Research Institute of Nigeria was expanded in 1975 by the Agricultural research Institutes establishment order No 107 under Agricultural research decree No 37 of 1973 to include tea with one of the objectives to improve the genetic potential, agronomic and husbandry practices including processes and storage of tea. However, adaptability of tea to the hotter and lowland ecologies of Nigeria begins as a result of inadequate of farm land on the plateau were tea is domiciled, competition among cattle grazing, tea farmers, industries and settlements. Table 3 below showed the adapted clones to the hotter and lowland ecology of Nigeria and their average yield in kg.

Table 3: Yield of adapted clones to the lowland area of Nigeria.

Clones	Yield/ha/yr(kg)
143	790.14
318	510.8
236	380.97
357	797.6

The available clones in the germplasm were evaluated under four different light/shade intensities and quality. No shade (100 % intensity) control, green plastic netting 85 % intensity, palm fronds 50 % and palm frond spread on green plastic netting 20%. Clones 318, 143 and 236 found suitable for lowland ecologies of Nigeria. Esan E.B.1984

In another studies to identify and to group clones under natural condition for hybridization, the following traits were observed, leaf size, shape, margin, colour and stem inter-nodes, flowering and fruit traits. The result led to 3 distinct groups vis-à-vis (1) Non flowering and Non fruiting clones these are clones (1) 14,25,35,74,108,143,318,353,357,359,363,367,368,369 and 370. (2) Regular flower and regular fruiting clones. These are 33, 68, 237,238 and 344. (3) This group is seasonally fruiting and seasonal flowering clones. Only 19 fall in this category. Esan E.B 1985. Rooting ability of tea is a great challenge to tea propagation especially in the nursery stage of tea production. However, the development of the appropriate technology for rooting selected clones was a great asset in commercial production of the crop. Two rooting promoting chemicals namely Beta –IBA at 100ppm, Boric acid at 40ppm as recommended by Esan E.B.(1984). The rooting promoting chemicals were evaluated in an improved humidity chamber at Onigambari, Ibadan. The results showed that more leaf flushes were observed in 6 weeks after treatment. In another related experiment, accession 318, 143 and OP236 were raised in the nursery under four different light/shade intensities and quality, 85%, 50%, 20% and control no shade (100% intensity) were used. The result showed that highest number of leaves was recorded for OP 236 (58) while 318 had the lease number of leaves (21). The highest number of branches recorded Op236 having 22.4 branches and clone 318 had the lease number of branches (11.3). The clone with longest shoot length (cm) and girth (cm) was 143 while the lease was 318, (Esan E.B. 1984). Omolaja and Esan (2005) in his studies titled Evaluation of High Altitude tea (*Camellia sinensis* (L) for adaptability of tea in lowland ecologies of Nigeria discovered that clone 143 showed the highest stability performance under ranging locations. He further stressed that since the contribution of the linear components in the genotype x environment interaction was significant. It suggested that the yield of tea clones studied in a given location is capable of being predicted with a reasonable level of accuracy. Therefore, clone 143 can be used in further breeding programmes. Esan E.B. (1989). In his efforts to characterize the clonal materials in Mambilla germplasm grouped the 29 clones into 6 distinct homogeneous classes. He discovered that the use of Principal Component Analysis (PCA) and Canonical Discriminant Function Analysis (CDA) were very effective for germplasm identification, conservation, hybrid indexing and information retrieval. Tea clones in the germplasm were characterized into eight groups using leaf traits. Esan E.B. 1990.

V. Tissue Culture in Tea Breeding

The newest non-conventional method of improving tea is through the application of plant tissue, cell and organ culture. Forest (1969) was the first to apply the technique to *in vitro* studies of tea. Having induced callus from tea stem cuttings, shoot apices and flower buds, he used this system to investigate biochemical processes of secondary natural products in the tea tissue. Recently, Esan E.B. (1989) reported for the first time the

direct induction of somatic embryo and natural size cotyledon regeneration *in vitro*. Host of other organs, structures and plantlets were also developed *in vitro*. Effective establishment of this technique will be helpful in *in vitro* hybridization and genetic manipulation on tea.

The quest to improvise for tissue culture substances locally in preparing nutrient media from pure natural components was promising. Trona and salt water were used as a substitute for the salt fraction in Skoog and Murashige which allowed for the germination of embryo axis and caused somatic embryogenesis. Esan. E.B. 1990

VI. TEA GENETIC EROSION

Selection pressure imposed during early domestication of tea in Nigeria and modern breeding activities result in cultivated varieties, which carry only a fraction of the variation present in the gene pool. At any point in time, the level and distribution of genetic diversity in a crop species depends on three variables: (1) the biological characteristics of the species, including its reproductive system, ploidy level and other genetic characteristics, (2) the biotic and abiotic factors and (3) the human environment (Gepts, 2004). The existence of human environment sets apart crop evolution from natural evolution. The amount of variability in a crop also varies depending on the type of genetic resource dealing with, e.g., whether it is present from wild genetic stock or whether it is a selected material from a breeding programme. In another study by Oloyede *et al.*, (2004) it was noted that tea is predominantly planted through stem cuttings, this may further narrow down the genetic base of the crop because individual genotype is being replicated. Therefore, there is need for mass germplasm collection in all tea growing regions in Nigeria to enrich tea gene pool in Nigeria.

VII. FUTURE FACTORS FOR TEA IMPROVEMENT IN NIGERIA

To improve tea economic status in Nigeria, there is need for improvement in such important factors as pest and disease incidence, abiotic factors especially climate change and other factors influencing tea production directly and indirectly. There is need for mass germplasm collection in all local government areas of Taraba State where tea is currently growing to improve tea germplasm with the aim of broadening the genetic base of available germplasm at experimental stations. However, based on the efforts of previous scientist to improve tea (C*amellia sinensis)*, there is need to be- up to-date with the recent trends in scientific investigations, so as to arrive at precise and overwhelming results. The role of biotechnology becomes important for meaningful progress to be achieved in this, since scientists have extensively explored morphological characterization. According to Adenuga *et al.*, (2012), it is sufficient to consider the use of further molecular markers to investigate tea germplasm and tea collection in Nigeria.

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