EVALUATION OF EXOTIC GENOTYPES OF TARO (*COLOCASIA ESCULENTA*) IN NIGERIA

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ABSTRACT

Production of Taro {Colocasia esculenta (L) Schott} in Nigeria had stagnated and even began to decline in the last few years due to several constraints including poor yield of local cultivars worsened by advent of taro leaf blight (TLB). Introduction and evaluation of exotic cultivars for adaptation to local production is a promising option to increase local variability, diversity and yield of taro. The objective of this experiment was to evaluate newly introduced (exotic) cultivars of Taro in order to identify and select those with high yield, TLB resistance and quality suitable for local production. Fifteen exotic cultivars of taro, obtained from International Network on Edible Aroids (INEA) as part of an EU-funded project on "Adapting Clonally Propagated Crops to Climatic and Commercial Change," and some local cultivar were evaluated in 2013 and 2014 at Umudike, located between latitudes 5°24′ to 5°30′ N and longitudes 7°31′ to 7°37′ E in the rainforest agro-ecological zone of Nigeria. The cultivars were laid out in a randomized complete block design in two replications. Results obtained indicate that most of the exotic cultivars were early maturing, four were intermediate while two (BL/SM/152, and BL/PNG/13) were late maturing. Most cultivars were susceptible to TLB; BL/PNG/13 was highly resistant while BL/SM/152 was immune. The late maturing cultivars were highly resistant/immune to TLB while most of the early maturing ones were susceptible thus suggesting a link between the genes for maturity and those for resistance to TLB. Cultivar differences in number of corms, cormels and total yield (corms + cormels) per plant were significant in both years. Total yield and Corm/Cormels ratio of many exotic cultivars compared favourably with the locals. Nine cultivars were selected as promising based mainly on yield, physical appearance, resistance to TLB and lack of stolon.

Keywords: Cocoyam, cultivars, corm/cormel ratio, taro leaf blight, maturity, total yield, corms and cormels

INTRODUCTION

Taro {*Colocasia esculenta* (L.) Schott} is better known locally in Nigeria as Cocoyam, a name it shares with another species of edible aroid known as *Xanthosoma saggitifolium*. It is a member of the Araceae family an ancient crop grown throughout the humid tropics for its edible corms, cormels and leaves, as well as for other traditional uses (Onwueme, 1994; Paul *et al*., 2013). In Nigeria, Taro is an important food crop whose leaves could be eaten as vegetable and corms and cormels eaten as sources of staple carbohydrate (Osuji and Nsaka, 2009) especially by the segment of the population that is most threatened by food security. It is cultivated essentially by small scale resource poor farmers mostly women (Ikwelle *et al*., 2003). Production had stagnated and even began to decline in the last few years due to several constraints, among which are neglect, narrow genetic base, low input, scarcity of planting materials, and various pre- and post-harvest biotic challenges, including taro leaf blight (TLB) (Amadi *et al*., 2012). Declining yields discouraged production as many farmers opted for other crops. There are ten cultivars of *Colocasia* mostly land races grown in Nigeria. All are susceptible to TLB ().

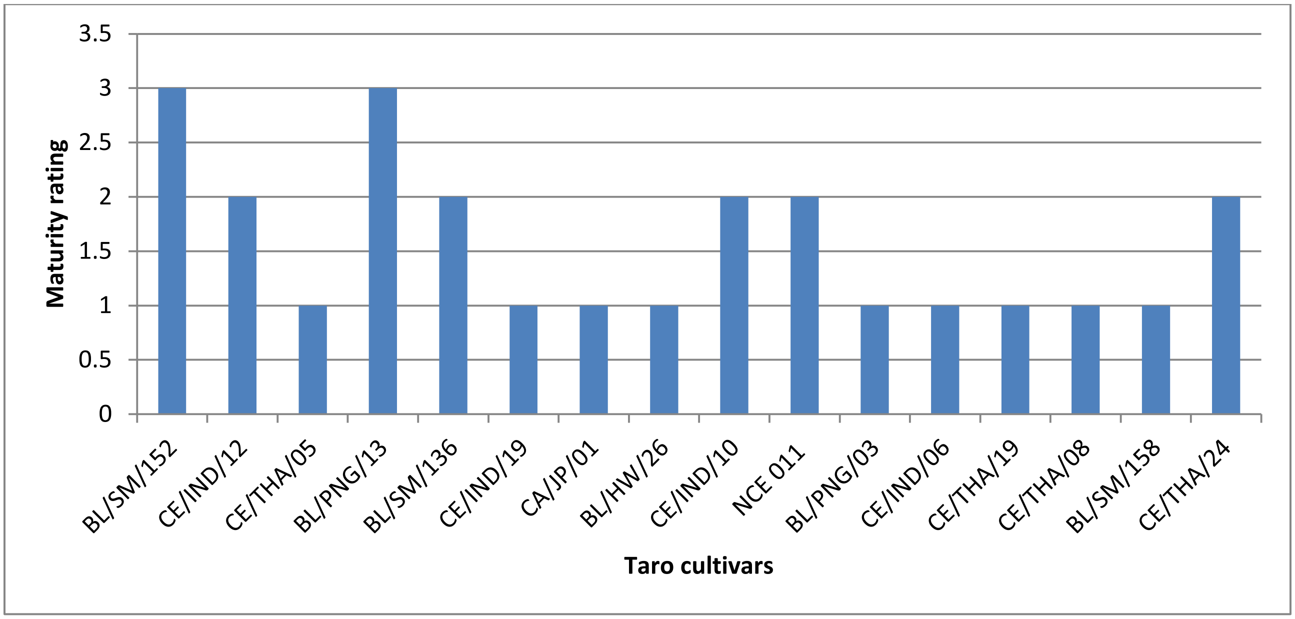
This limited number of genotypes and the resulting narrow genetic base may partly be responsible for the yield stagnation being experienced in recent years. Effort to develop new varieties by conventional means is hampered by poor, erratic flowering and lack of seed set by the local cultivars (Amadi *et al*., 2012). Introduction and evaluation of cultivars from other countries for adaptation to local production is a promising option to increase local variability, diversity and yield of Taro. Exotic cultivars of taro were recently obtained from International Network on Edible Aroids (INEA) as part of an EU-funded project on “Adapting Clonally Propagated Crops to Climatic and Commercial Change”. This paper presents the report of evaluation of these newly introduced (exotic) cultivars of Taro. The objectives of the project were to identify and select those cultivars with high yield, TLB resistance and quality suitable for local production and consumption.

MATERIALS AND METHOD

The study was conducted on a sandy clay loam Haplic Acrisol with udic and isohyperthermic soil moisture and temperature regimes at Umudike, located between latitudes 5°24′ to 5°30′ N and longitudes 7°31′ to 7°37′ E in the rainforest agro-ecological zone of Nigeria. The area is typical of the degraded humid forest ecology, characterized by a bi-modal annual precipitation that could be >2000 mm, with air temperature ranging from 22 to 31°C, and high relative humidity (77 %) during the wet season and five sunshine hours on average per day (Chukwu, 2013). Fifteen exotic cultivars - BL/SM/152, CE/IND/12, CE/THA/05, BL/PNG/13, BL/SM/136, CE/IND/19, CA/JP/01, BL/HW/26, CE/IND/10, BL/PNG/03, CE/IND/06, CE/THA/19, CE/THA/08, BL/SM/158, CE/THA/24 and a local cultivar NCE 011 (Check) were evaluated in 2013 while in 2014, five more local cultivars - NCE 1, NCE 3, NCE 4, NCE 5, NCE 12 were included in trial. The cultivars were laid out in a randomized complete block design in two replications. Planting for each year was in the month of May when the rains were established. One cormel or sliced corms sett was planted per stand at inter and intra row spacing of 1m giving a plant density of 10,000 plants per hectare. Weeds were controlled by the application of a mixture of pre and post emergence herbicide a week after planting. This was followed by manual weeding at 12 and 16 WAP. At six weeks after planting, 400kg/ha of NPK 15:15:15 was applied as basal dressing. Plants were harvested during the first week of December. Data collected were maturity rating (Key: 1 = Early, 2 = Intermediate, 3 = late maturity); response to TLB {Scale: 0 = Immune (No Taro Blight), 1 = Few blight spot (less than 10%), 2 = 10 - 30%, 3 = 31 - 50%, 4 = 51 - 70%, 5 = 71 - 90% and 6 = totally destroyed}; number of corms; number of cormels; corm/cormel ratio; and total yield (corms + cormels). Data was analyzed using genstat discovery edition software.

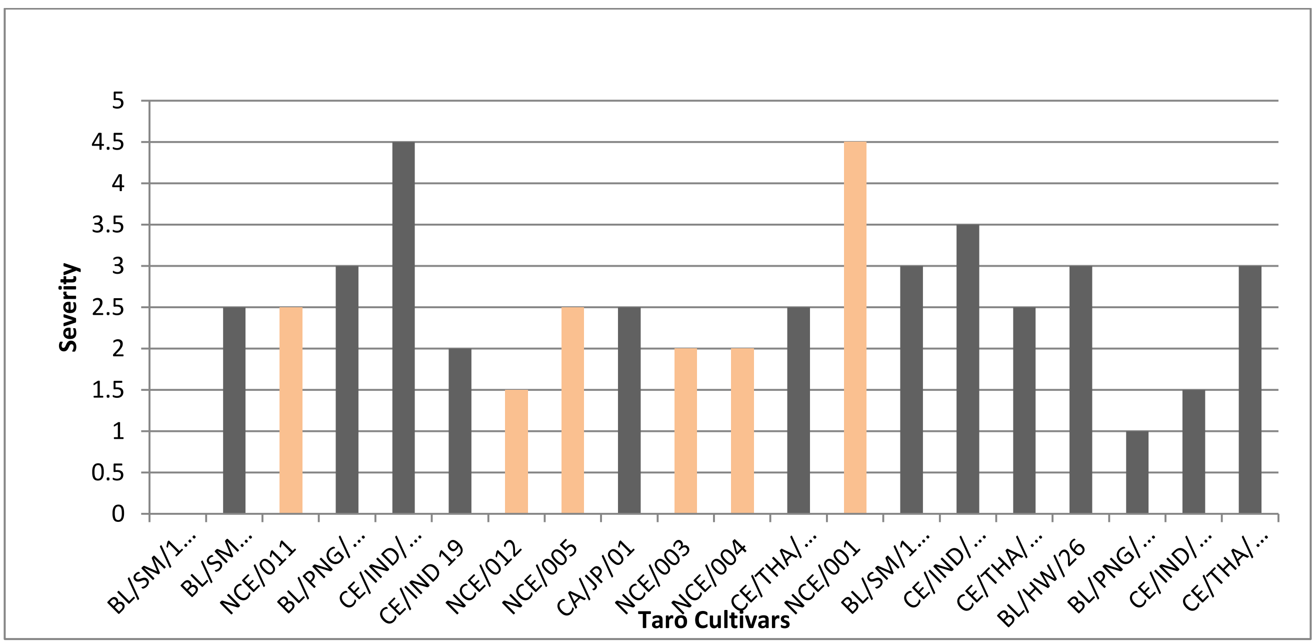
RESULTS AND DISCUSSION

Maturity rating of exotic taro cultivars and the local check are shown in Fig 1. Most of the cultivars were early maturing, four were intermediate while two (BL/SM/152, and BL/PNG/13) were late maturing. Early maturity is a desired characteristic since it means the crop will be available for consumption early. In addition, it may help the cultivar to escape the peak period of disease incidence. TLB rating of the cultivars are shown in Fig 2. Most of the cultivars were susceptible to TLB while BL/PNG/13 and BL/SM/152 were highly resistant and immune respectively. Amadi *et al.,* (2015) reported that BL/SM/152, was suitable both as a male and a female parent for hybridization and that it exhibited most of the indices of good and productive flowering in taro described by Ivancic *et al*. (1996), which include vigorous growth, continuous occurrence of floral clusters, 4–5 inflorescences per cluster, well-developed spadices, a high proportion of fertile female flowers, an abundance of pollen, an intense odor a day before pollen release, many insects (flies, bees) inside or outside the inflorescence, good seed set and a well-developed fruit head. It will therefore be a good source for TLB resistance gene introduction into local cultivars.



Key: 1 = Early, 2 = Intermediate, 3 = late maturity

Fig. 1: Maturity rating of Taro Cultivars



Scale: 0 – Immune (No Taro Blight), 1 - Few blight spot (less than 10%), 2 - 10 - 30%, 3 - 31 - 50%, 4 - 51 - 70%, 5 - 71 - 90% and 6 - Totally destroyed

Fig. 2: Reaction of Exotic and Local Cultivars of Taro to TLB in 2014

Tuber yield characteristics of exotic taro genotypes and the local checks in 2013 and 2014 are presented in Tables 1 and 2 respectively. Mean number of corms/plant ranged from 1 to 2 in 2013 and 1 to 3.5 in 2014. Cultivar differences in number of corms per plant were significant in both years. There were also significant differences between taro cultivars in number of cormels per plant in both years. In 2013, the highest number of cormels (21 per plant) was produced by cultivar CE/THA/05 but was not significantly different from seven other cultivars in this attribute. CE/IND/12 produced the highest number of cormels/plant in 2014. Corm/Cormels ratio of many exotic cultivars compared favourably with the locals. Most local consumers of Taro prefer the cormels to the corms. Tuber rots at harvest was observed in only a few cultivars and it was low (Table 2).

Table 1: Tuber yield Characteristics of Exotic Taro in 2013

Genotype	Number of Corms/plant	Number of cormels/plant	Corm/cormel ratio	Total yield /Plant (kg)	Remarks
BL/SM/152	1.67	15	0.11	1.52	No Stolon
CE/IND/12	1.33	17.33	0.08	1	No Stolon
CE/THA/05	1.67	20.83	0.08	0.74	No Stolon
BL/PNG/13	2	16	0.13	0.72	No Stolon
BL/SM/136	1	3.33	0.30	0.72	No Stolon
CE/IND/19	1.67	14	0.12	0.49	Stolon
CA/JP/01	1	16	0.06	0.48	No Stolon
BL/HW/26	2	15	0.13	0.46	Long stolon
CE/IND/10	1	6.33	0.16	0.45	Long stolon
NCE 011	1.17	14	0.08	0.39	No Stolon
BL/PNG/03	1	12	0.08	0.36	No Stolon
CE/IND/06	1	2.33	0.43	0.36	Short stolon
CE/THA/19	1	11.33	0.09	0.27	No Stolon
CE/THA/08	1.17	10	0.12	0.22	Long stolon
BL/SM/158	0.5	7.5	0.07	0.22	No Stolon
CE/THA/24	1.33	3.67	0.36	0.10	Long stolon
SED	0.49	3.508	0.14	0.21	

Total yield (corms + cormels) ranged from 0.10kg/plant in cultivars CE/THA/24 to 1.52kg/plant in cultivar BL/SM/52 in 2013; and from 0.43kg/plant in cultivar CA/JP/01 to 2.3kg/plant in a local cultivar NCE 004 in 2014. The variation in total yield amongst taro cultivars was significant ($P \leq 0.05$) in both years. Significant variability in total yield in some aroids has been reported by various authors (Paul *et al*., 2013; Fantaw, *et al*., 2014).

Table 2: Tuber yield characteristics of Taro in 2014

Clonal ID	Number of corms	Number of Cormels	Corm/Cormel Ratio	Number of rotten tubers	Tuber Yield (kg)
BL/HW/26	1	10	0.10	0	0.48
BL/PNG/03	1	7.5	0.13	0	0.58
BL/PNG/13	1	8.5	0.12	0	0.48
BL/SM/136	2	14.5	0.14	0	0.63
BL/SM/152	3.5	12.5	0.28	0	1.7
BL/SM/158	1.5	33	0.05	1	1.13
CA/JP/01	1	15.5	0.06	0.5	0.43
CE/IND/10	3	30	0.10	0	0.65
CE/IND/12	3.5	45.5	0.08	0	1.38
CE/IND/19	1	22.5	0.04	0	1
CE/THA/05	3.5	29.5	0.12	0	1.35
CE/IND/06	1.5	9	0.17	0	0.75
CE/THA/08	1	14.5	0.07	0	0.53
CE/THA/19	1	26	0.04	0	0.5
CE/THA/24	1.5	18.5	0.08	0	0.5
Nce 001	1	18.5	0.05	0	0.95
Nce 003	1	25.5	0.04	0	0.8
Nce 004	3.5	22	0.16	0	2.3
Nce 005	1	14.5	0.07	0	0.98
Nce 011	1	25.5	0.04	0	1.03
Nce 012	1	31	0.03	0	1.48
SED 0.05	0.73	7.6	0.096	0.34	0.41
CV%	44.2	37.9	35.3	28.3	44.8

The mean total yield of the cultivars was significantly higher in 2014 than in 2013 though cultivar by year interaction was not significant (Table 3). Edaphic factors are likely responsible for this significant year effect on mean total yield. Most exotic genotypes compared favourably with the locals in terms of total yield.

Correlation coefficients for the relationship between assessed attributes of taro are presented in table 4. Time of maturity, number of corms, and cormels correlated positively and significantly with total yield. Later maturing cultivars probably had more time to produce and accumulate assimilates hence the significant positive correlation between time of maturity and total yield. It has been previously reported that total yield per plant was positively and significantly correlated with number of corms and cormels per plant (Velayudhan, *et al*., 2000; Cheema *et al*., 2006). There was a significant negative correlation between TLB and total yield implying a yield reduction due to TLB. Reduction in yield due to TLB has been widely reported (Singh *et al*., 2006; Nelson *et al*., 2011, Singh *et al*., 2012). TLB, destroy leaves of taro plants thereby reducing their capacity to produce assimilated for storage. There was very highly significant negative correlation between maturity and TLB. The late maturing genotypes were highly resistant or immune to TLB while most of the early maturing ones were susceptible thus suggesting a link between the genes for late maturity and those for resistance to TLB. This possibility of linkage between gene for late maturity and TLD resistance merits further study. In the end, nine cultivars - BL/SM/152, CE/IND/12, CE/THA/05, BL/PNG/13, BL/SM/136, CA/JP/01, BL/PNG/03, CE/THA/19, BL/SM/158 were selected as promising based mainly on yield, physical appearance, resistance to TLB and lack of stolon. These will be further evaluated with farmers in the coming years to help popularize them prior to possible release.

Table 3: Effect of cultivar and year of planting on Total yield of Taro

	Year		
Cultivar	**2013**	**2014**	**Mean**
BL/HW/26	0.290	0.475	0.383
BL/PNG/03	0.478	0.575	0.526
BL/PNG/13	0.938	0.475	0.706
BL/SM/136	0.750	0.625	0.688
BL/SM/152	1.575	1.700	1.638
BL/SM/158	0.115	1.125	0.620
CA/JP/01	0.562	0.425	0.494
CE/IND/06	0.340	0.750	0.545
CE/IND/10	0.475	0.650	0.562
CE/IND/12	1.150	1.375	1.262
CE/IND/19	0.512	1.000	0.756
CE/THA/05	0.850	1.350	1.100
CE/THA/08	0.213	0.525	0.369
CE/THA/19	0.175	0.500	0.338
CE/THA/24	0.105	0.500	0.302
NCE 011	0.455	1.025	0.740
Mean Year	0.561	0.817	

SED Cultivar = 0.2334; SED Year = 0.0825; SED G x Y = 0.3301

Table 4: Correlation between some attributes of taro

Attributes	**Correlation coefficients**				
Maturity	0.39**				
TLB	-0.32**	-0.63***			
Num_Corms_Plant	0.63***	0.32**	-0.20		
Num_cormels_plant	0.54***	0.02	-0.04	0.47***	
	Total yield /plant (kg)	Maturity	TLB	Number of Corms /Plant	Number of cormels /plant

* = P≤0.05, ** = P≤0.01, *** = P≤0.001. Number of observations: 64

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