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Development of high yielding Taro (*Colocacia esculenta L.)* Variety for mid altitude growing areas of Southern Ethiopia

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Abstract: Seasonal food shortage is amongst the principal problems of farmers in mid-altitude areas of Southern Ethiopia. In some of the world's poorest nations, taro and sweet potato are important part of food security packages. Globally, taro is grown over a wide range of environments from 1,300-2,300m.a.s.l.; mostly by the resource poor farmers. Its compatibility with various types of limited in put farming systems (versatility) and reliability under conditions such as drought, high rain fall, and low soil fertility have made it attractive crop to farmers. There is no improved variety of taros so far released to farmers, and hence this trial was carried out to develop high yielding taro for the region and for possible official release. The experiment was carried out using RCB design at three distinctive locations namely Areka, Donga Tunto and Yirga-chefe using 11 taro accessions plus one local check from the respective locations during 2000-2002. There were significant difference exists among the materials tested and the top yielder variety (ARC/064/96) was promoted for further verification trial on farmer's field. From the results of verification trial it was observed that farmers show great interest towards the candidate variety on top of the local ones. Finally after repeated evaluation made by National Variety Releasing Committee (NVRC), this variety has officially been released for mid altitude agro-ecology and similar growing areas of SNNPR with wet heavy fertile soil. The new variety is named as Boloso-one.

Keywords: Boloso, Development, High yield, Southern, Taro

1. Introduction

Taro (*Colocasia esculenta* (L.) Schott) is a herbaceous, monocotyledonous, perennial stem root crop that is widely cultivated in tropical and subtropical regions of the world. It is originated from tropical areas of South and Southeast Asia and the Pacific Islands (Jianchu, *et al.,* 2001) and then arrived in the east coast of Africa over 2000 years ago(TPI, 2000-2004). Today it is grown in nearly all parts of the humid tropics. It is a globally important crop, ranked fifth in area and production after cassava, potato, sweet potato and yam (FAO 2010; Tewodros 2013).

In Ethiopia, it is cultivated and utilized extensively in South, South Western and Western parts of the country as food and fill economic problem. For the last five-years reported data indicated that taro ranks 3nd followed by sweet potato both in terms of area coverage and production among the major root crops (Irish potato, cassava, enset and others) grown in major growing regions of the country. According to the Simon Adebo (1992), Farm Africa report, about two in every three farmers, in Wolaita Zone currently grow taro, due to the acute problem caused by Enset bacterial wilt and Sweet potato butter fly, the human population previous degree of dependence on these two staple food crops is being reduced in favor of maize and taro. Moreover, taro is cultivated because of its exceptionally high yield, resistance to disease and pests, wide ecological adaptation ease of management as a crop, storage for a longer period and availability when needed for consumption (Simon, 1992; Edossa, 1995; Tewodros, 2012*)*. Despite its importance, the production and productivity of taro deteriorating and the yield became low. Besides, the taro genetic resources are being eroded by physical and bio-physical factors (Edosa, 1996). As a result, the country frequently faces a considerable amount of food shortage for the last decades (Tewodros, 2012). Therefore, collection, introduction of taro genotypes from abroad and

development of new varieties is the best means to increase production and productivity of the crop.

Taro genetic improvement starts with the assembly and evaluation of a broad germplasm base, followed selected elite clones and careful evaluation in a set of representative environments. For this study, about 87 accessions of taro were collected from major growing areas of the country particularly of the Southern, South western and Western parts of Ethiopia during 1996-1997 cropping seasons maintained at Areka Agricultural Research Center and evaluated at every stage of breeding programs, characterized and screened to identify high yielding, relatively resistance to major disease and pests with better agronomic merits for growing areas in the region. There for this trial was under taken to develop high yielding taro variety for the region and for possible official release.

2. Materials and Methods

2.1. Description of the Study Area

The experiment was conducted at three locations namely Areka, Yirgachefe, and Donga tunto for two cropping seasons (2000-2002) with an altitude of 1850, 1600, and 1550 meter above sea level. The area receives mean annual rainfall of 1432 mm,1630 mm and 1400 mm with mean annual temperature of 29.2 ^{0} C, 28.0 ^{0} C and 24 ^{0} C, respectively. The soil all tested sites are Eutric Nitosole (reddish brown) with pH of 5.7.

2.2. Accessions Evaluations

A total of 10 elite taro accessions were considered in this study. The accessions were screened from 87 accessions collected from south and south-western parts of Ethiopia. The collections covered diverse agro-ecologies with an altitude range of 1130-2340 m.a.s.l, representing one of the major taro production areas in the country. The name accessions ARC/004/95, ARC/0 26/96, ARC/038/96, ARC/042/96, ARC/044/96, ARC/047/96, ARC/064/96, ARC/065/96, ARC/074/96, ARC/080/96 and local check.

2.3. Experimental Design and Management

The study was laid randomized complete block design with three replications. Each plot size 20m^2 with spaced 100cm x 70cm between rows and plants respectively for all locations. Harvesting was done from ten months after planting. Data was collected for plant height, number of corm or cormel per plant, marketable, unmarketable and total root yield. Data was analyzed using SAS-soft ware.

2.4. Statistical Analysis

Individual and combined data from 2008-2010 were analyzed using SAS software package (SAS, 9.1) and means were separated by DMRT at *p= 0.01* and *0.05* level of significance and their correlation.

3. Results and Discussion

The result of the experiment showed that there was significant difference exhibited in fresh marketable and total root yield among the accession utilized across locations (Table-1). Accessions ARC/064/96 and ARC/ 047/96 gave the highest mean total root yield of 22.87 t/ha and 20.22t/ha respectively (Table-2). In general, the yield recorded ranged between 4.72- 28.77t/ha over locations as a result of genotype differences.

Table 1. *Mean total root yield of taro accession across locations (t/ha.)*

Treatment	Location			Mean of location
	Areka	Donga tunto	Tumata cherecha	
ARC/004/95	13.84abc	7.81b	15.98abc	12.54
ARC/026/96	9.048c	6.91b	9.84c	8.58
ARC/038/96	9.10c	5.44b	10.26c	8.27
ARC/042/96	10.45bc	7.69b	16.30ab	11.48
ARC/044/96	15.21abc	10.77ab	13.97abc	13.32
ARC/047/96	20.00a	12.22ab	27.04a	19.75
ARC/064/96	18.54ab	17.33a	29.95a	21.64
ARC/065/96	9.21c	9.47b	12.54abc	10.41
ARC/074/96	18.65ab	8.23b	8.21c	11.69
ARC/080/96	15.51abc	8.47b	14.67c	12.88
Local	11.72abc	6.59b	7.19c	8.50
CV %	36.9	44.9	44.2	
LSD (0.05)	8.46	6.9	11.53	

♦ Means were separated by DMRT, those followed by the same letters are not significantly different at (P=0.05)

The result of combined analysis over years and locations was observed that the highest significant yield was recorded at Yirga-chefe (29.80 t/ha) in the year 2000/01 cropping season, followed by Areka (18.54t/ha) and Donga tunto (17.33t/ha), but, the highest root yield in the year 2001(02) cropping season was recorded at Areka (39.00t/ha) followed by Yirga chefe (18.30 t/ha) and Donga tunto (14.23 t/ha).

The yield obtained from the local check of Donga tunto was significantly inferior to all accessions than the one which were employed for Areka and Yirga chefe locations, which might be due to the compact nature the soil in the trial sites which create problems for root penetration and enlargement. The local check at Areka gave as high yield as the out yielded accessions but with much lower yield magnitude.

Table 2. *Two years across location (Yirgachafe, Areka and Donga Tunto) mean root yield of different taro accessions (t/ha.)*

Treatment	Year		Mean of
	2000/2001	2000/2002	
ARC/004/95	12.54	9.78	11.17
ARC/026/96	8.58	10.26	9.43
ARC/038/96	8.27	10.44	9.36
ARC/042/96	11.48	11.43	11.46
ARC/044/96	13.32	10.13	13.18
ARC/047/96	19.75	20.64	20.22
ARC/064/96	21.94	23.85	22.87
ARC/065/96	10.41	13.69	12.05
ARC/074/96	11.69	13.22	12.46
ARC/080/96	12.88	12.73	12.36
Local	8.50	15.09	11.79
Mean	12.58	14.01	12.30

Table 3. *Mean fresh toot yield of taro accessions (t/ha) (combined over years and locations.)*

Trt. no	Location									Over all mean
	Yirgachfe			Areka			Dongatunto			
	Year			Year			Year			
	200/01	2001/02	Mean	200/01	01/02	Mean	200/01	2001/02	Mean	
1	15.98bc	11.85bc	13.92	13.84abc	13.70c	13.77	7.81 b	3.80 d	5.81	11.17
2	9.84c	10.53c	10.19	9.07c	14.33c	11.70	6.90 b	5.92 cd	6.41	9.43
3	10.26c	12.92abc	11.61	9.10c	14.77c	11.94	5.44 b	3.60 d	4.52	9.36
4	16.30bc	12.17bc	14.24	10.45bc	16.98c	13.72	7.70b	5.13cd	6.42	11.46
5	13.97c	12.06bc	13.02	15.22abc	20.10bc	17.66	10.77ab	6.93 c	8.55	13.18
6	27.14ab	19.05a	23.10	20.00a	32.35ab	26.18	12.22ab	10.53 b	11.38	20.22
7	29.80a	18.30ab	24.05	18.54ab	39.00a	28.77	17.33a	14.23a	15.78	22.87
8	12.54c	18.46ab	15.50	9.21c	17.01c	13.11	9.47 b	5.60 cd	7.54	12.05
9	8.21c	12.17bc	10.19	18.6ab	20.66bc	19.66	8.23 b	6.83 c	7.53	12.46
10	14.67bc	14.71abc	14.69	12.5abc	18.62c	15.57	8.46 b	4.86 cd	6.66	12.36
11	7.17c	16.72abc	12.00	11.7abc	21.42bc	16.57	6.58b	7.04 c	6.81	11.79
Cv (%)		44.94		27.07		37.36	31.31		24.27	44.16

Means were separated by DMRT, those followed by the same letters are not significantly different at (P=0.05).

However, the best performing accession, ARC/064/96, exhibit some of the following unique advantages in all of the trial sites. High yield, resistance to taro leaf blight, cooks well and remains powdery when boiled, free from un pleasant irritating substance, preferred to systematic harvesting of the cormeles and corms, relatively early maturing and its contribution to food security is high. The farmers evaluated these and other merits of this variety during the one-year on farm verification trial. The on farm verification was carried out at Areka (one on station, two on farm, namely Bombe and Hembecho) in Wolita Zone, Yirgachefe, on farm in Gedio Zone, Waka on farm in Dauro Zone. From the one-year verification trial, it was observed that in all of the trial sites (ether on station or on farm), the candidate variety gave the highest total and marketable root yield than the respective local check (Table 3).

Farmers' preference was also assessed during the entire period of the trial. The results indicated that, farmers had great interest on the candidate variety (Table-4), because of the merits associated its high yielding character, good taste (sweeter), being remained powdery when cooked, it gave greater number of smaller cormels and it is resistance to disease and above all it out yielded the local variety by 67 % on average of the marketable yield.

***Table 4**. Farmer's selection criteria and ranking of taro varieties across locations (n=7)*

No	Criteria	Locations and number of Farmers involved in evaluation							
		Bombe		Hadaro		Areka		Himbecho	
		Candidate	Local	Candidate	Local	Candidate	Local	Candidate	Local
1	Non-irritability	4	0	4	0	3	0	4	4
2	Earliness in maturity	4	2	4	3	4	2	4	2
3	Ease of cooking	4	3	4	3	3	2	3	4
4	Powdery ness when cooked	4	3	4	2	4	2	4	4
5	Palatability	3	3	4	4	3	4	4	3
Rank		1	2	1	2	1	2	1	2

Key: 4= mean best; 0= mean worst

***Table 5.** Total root yield of taro (t/ha.) of the candidate and respective local check varieties from on-farm and on-station sites.*

Variety	On station	On farm verification sites			
	Areka	Himbecho	Bombe	Hadaro	Waka
ARC–064/96	23.19	38.98	56.54	47.57	21.58
Local	10.52	16.78	16.22	12.32	10.41

4. Conclusion and Recommendation

Based on the approval of the National Variety Releasing Committee (NVRC) the candidate variety ARC/064/96 has officially been released for mid altitude and similar growing areas of Southern Ethiopia with wet heavy fertile soil. The new variety is named as Boloso-one.

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