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Original Research

Preliminary Study for Production of Anchote (*Coccinia abyssinica* (Lam.) Cogn.) in Western Part of Ethiopia

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Abstract

The experiment was carried out at Wollega University, Nekemte campus during 2013 crop growing season to evaluate 15 anchote genotypes for higher root tuber yield and other related agronomic traits. The treatments were arranged in randomized complete block design and each treatment was replicated three times. All management practices were uniformly applied in all plots. The results indicated that the genotypes were significantly ($P \leq 0.01$) different for days to 50 % flowering and days to 95% fruit setting while non significant ($P > 0.05$) differences were observed for fruit length, fruit diameter, root length, root tuber diameter, and root tuber yield. Though not significant, genotypes were variable for all studied traits. Eight viz. Haro_2, Ilfata_2, Jalale_1, Babo_1, Ilfata_1, Gute_1, Tinfa_4, and Darabata_3 genotypes were selected for higher root tuber yield for further over locations adaptability testing.

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INTRODUCTION

The major food security challenges in Ethiopia are population growth, nutrient deficiencies, diseases/AIDS, environmental degradation, drought and climatic change. In South Western coffee growing areas, farmers are dependent mainly on coffee as cash income. In this region, food crops are obtained through purchase from the market though some crops like maize and sorghum cereal crops are grown for home consumption. However, the importance of root crops like Anchote, Yam, Taro and Oromo Dinich lies on the nutritional importance, cheap food crop specially available during a food shortages for poor people, grown easily under traditionally managed system. Therefore, these indigenous food items have a vast potential for addressing the food security, health and other needs of the poor. Root and tuber crops have good nutritive value and phyto-chemical contents, which are beneficial to the human health. These include the proteins, carbohydrates, fats, minerals, vitamins and the phytochemicals are alkaloids, tannins, phenols, flavonoids and saponins (Okwu and Ukanwa, 2007).

Demissie (1998) reported that enset (*Ensete ventricosum)*, anchote (*Coccinia abyssinica)*, Oromo dinich (*Plectranthus edulis)*, *Amorphophallus abyssinica* and *Abelmoschus esculentus* are some of the little known but potentially useful crop species in Ethiopia. They, however, have received little attention by research and development activities so far. Mathenge (1995) further indicated that proper documentation of the available information related to under-utilized crops on distribution, use and traditional knowledge is essential. The information will be valuable in order to maximize the conservation and further utilization of these crops.

Anchote (*Coccinia abyssinica*), yam (*Dioscorea alata)*, Taro (*Colocasia esculenta*) and Oromo Dinich (*Coleus edulis)* crops are important root crops of south western Ethiopia. These crops are widely grown in Wollega, Illubabor, Jimma, Southern Nations and Nationalities under traditional managed cropping systems. They are commonly planted in home gardens by small scale farmers and produce roots and/or tuber in underground part. Relatively the crops can give high yield per unit area under low input systems. The important nature of these crops are drought resistant, can stay in the soil until it is required for consumption or sale, has high carbohydrate and other nutritional contents which are important food stuffs, produced under traditional management system with farmers knowledge and practices, and relatively less susceptible to insect and disease pests.

According to Gemeda (2000) farmers of West and East wollega Zones are growing root and tuber crops (anchote, dinicha Oromo and yam) in their homesteads and using them for longer period of the year. These crops are grown as security crops against crop failure. However, the conservation practices, food values and extent of genetic variations were not so far investigated for the two species.

Food prepared from Anchote is currently among the popular dish prepared in big restaurants in towns mainly because of its nutritional quality and cultural food in western part of Ethiopia. Because of these reason, it is highly demanded in the market. On top of that, it is among the cultural food which is prepared during religious and non-religious holidays. The popularity of anchote dish is

increasing in the towns. How ever there was no variety released for small/large scale production in western Ethiopia. Therefore, the objective of the study was to develop anchote variety/ies with higher tuber yield and tuber quality for small-scale production in the western Ethiopia.

MATERIAL AND METHODS

Experimental Site

The experimental site was Nekemte campus. Nekmte is a midland where different kinds of crop varieties are grown. Among these are sorghum, tef, maize, haricot bean, and different kinds of vegetables and root crops of which anchote is one.

Experimental Materials

Forty-nine anchote landrace varieties were collected from different regions of western Ethiopia and evaluated at one location during 2012 cropping season for tuber yield production. From the 49 landraces, based on the performances of the varieties for yield and yield related traits, 15 varieties were selected for evaluation of tuber yield and quality parameters at Wollega University, Nekemte campus during 2013 cropping season (Table 1).

Design and Data Management

The experiment was laid in Randomized Complete Block Design with three replications. The plot size was (4rows x 2m length x 0.5m spacing between rows x 0.2m spacing between plants = $4m^2$). Fertilizer was applied using the recommendations given to other root crops like Irish Potato, etc. All the agronomic practices such as weeding, staking, etc. were followed uniformly for all the treatments as per required.

Data Collection and Analysis

Phenological data: days to 50% flowering, days to 95 % fruit setting, fruit length, fruit diameter, and yield related traits: Root length and root diameter, root tuber yield were recorded and analysed using SAS software ver. 9.0 USA.

RESULTS AND DISCUSSION

Analysis of Variance

The analysis of variance showed that the genotypes were high significantly different for days to 50 % flowering and days to 95 % fruit setting (Table 2). The genotypes showed non-significant differences for other traits such as fruit diameter, fruit length, tuber diameter, tuber length and tuber yield.

Table 1: Accessions of the 15 anchote genotypes grown in 2013 at Nekmte campus

No.	Genotypes	Origin	
		District	Zone
1	Haro_2	Wayu Tuka	East Wollega
2	Jalale_2	Sibu Sire	East Wollega
3	Ilfata_2	Wayu Tuka	East Wollega
4	Jalale_1	Sibu Sire	East Wollega
5	Babo_1	Hawa Galan	Kellem Wollega
6	Ilfata_1	Wayu Tuka	East Wollega
7	Gute_1	Wayu Tuka	East Wollega
8	Tinfa_4	Guto Gida	East Wollega
9	Ilfata_4	Wayu Tuka	East Wollega
10	Darbata_1	Wayu Tuka	East Wollega
11	Kichi_2	Wayu Tuka	East Wollega
12	Haro_3	Wayu Tuka	East Wollega
13	Michael_1	Gimbi	West Wollega
14	Darabata_3	Wayu Tuka	East Wollega
15	Babo_3	Hawa Galan	Kellem Wollega

Table 1: Mean square values of the genotypes for the 7 agronomic traits of anchote genotypes evaluated at Nekemte in 2013 cropping season

Agronomic traits	Df	Mean square values	F calculated	Significance level
Days to 50 % flowering	14	41.78	36.46	**
Days to 95 % fruit setting	14	39.74	36.18	**
Fruit diameter, cm	14	0.99	1.8	ns
Fruit length, cm	14	2.08	1.44	ns
Tuber diameter, cm	14	2.78	0.63	ns
Tuber length, cm	14	5.03	1.53	ns
Tuber yield, kg/4 m^2	14	0.76	0.32	ns

** and ns indicates significant ($P \leq 0.01$) and non significant ($P > 0.05$) respectively. Df- degrees of freedom.

Days to 50 % flowering and days to 95 % fruit setting

Anchote genotypes were highly variable for days to 50 flowering, and days to 95 % fruit setting as can be realized from mean ranges and standard deviations. Genotypes such as Ilfata_2, Babo_1, Gute_1, Tinfa_4 and Darbata_3 are relatively early in flowering and fruit setting. And genotypes Jalale_2, Ilfata_4, Darabata_1, Michael_1 and Babo_3 are relatively late in flowering and fruit setting. The other genotypes are medium in days to flowering and fruit setting (Table 3 and 4; Figure 1).

Fruit Diameter and Fruit Length

High coefficients of variation were observed for fruit diameter and fruit length. Anchote genotypes were highly variable for tuber length as can be realized from mean ranges and standard deviations. Regarding these traits, genotypes with higher fruit diameter include Tinfa_4, Ilfata_4, Haro_3 and Darbata_3 while genotypes with higher fruit length include Jalale_1, Tinfa_4 and Haro_3 (Table 3 and 4 and Figure 1).

Tuber Diameter, Tuber Length and Tuber Yield

High coefficient of variation was observed for tuber yield. Genotypes with higher tuber diameter include Jalale_1, Darbata_1, Harao_3 and Babo_3 while genotypes with higher tuber length include Jalale_2, Jalale_1, Ilfata_1 and Haro_3 (Tables 3 and 4 and Fig. 1). Genotypes with higher tuber yield included Haro_2, Ilfata_2, Jalale_1, Babo_1, Ilfata_1, Gute_1, Tinfa_4, and Darabata_3 (Table 3) and these genotypes are selected for the next time multisite testing. Mengesha *et al.* (2012) evaluated ten anchote accessions in Ebantu (East Wollega) and Jima conditions for tuber yield and related traits. The authors recommended six accessions for production for their better performances. However, recommendation based on one year experiment is not valuable since yield and yield related traits of the crops are influenced by environment. Therefore, further testing of genotypes over locations and years is necessary to come up with stable variety for economic traits.

Table 2: Descriptive statistics for the 7 agronomic traits of anchote genotypes evaluated at Nekemte in 2013 cropping season

Agronomic traits	Mean	St. Err.	St. Dev.	Minimum	Maximum
Days to 50 % flowering	79.36	0.964	3.732	74.33	83.67
Days to fruit 95 % setting	115.31	0.940	3.639	110.67	120.33
Fruit diameter, cm	3.48	0.148	0.575	2.50	4.30
Fruit length, cm	6.08	0.215	0.833	5.10	7.90
Tuber diameter, cm	7.92	0.249	0.963	6.50	9.33
Tuber length, cm	12.08	0.334	1.295	10.33	15.17
Tuber yield, kg/4 m^2	4.03	0.239	0.924	1.00	5.17

Table 3: Mean agronomic traits of the 15 anchote genotypes grown in 2013 at Nekmte campus

No.	Genotypes	DF	DFS	FD	FL	TD	TL	RTY
1	Haro_2	79.67	111.67	3.5	6.63	7.33	11.50	4.00
2	Jalale_2	83.00	119.33	3.0	5.20	8.00	13.67	3.50
3	Ilfata_2	74.33	110.67	2.5	5.70	7.50	11.50	4.67
4	Jalale_1	80.33	114.33	3.6	7.20	9.33	13.17	4.00
5	Babo_1	75.00	119.67	3.3	6.00	7.17	11.50	5.17
6	Ilfata_1	80.00	115.33	3.9	5.10	7.17	13.33	4.50
7	Gute_1	74.33	115.67	2.8	5.43	7.00	12.33	4.33
8	Tinfa_4	75.00	111.00	4.2	7.10	8.33	10.67	4.17
9	Ilfata_4	83.67	115.67	4.0	6.33	7.67	12.17	3.83
10	Darbata_1	83.33	119.67	3.7	5.57	9.17	11.67	3.50
11	Kichi_2	79.67	111.67	2.5	5.27	8.50	10.83	3.83
12	Hatro_3	80.33	114.67	4.3	7.9	9.00	15.17	3.50
13	Michael_1	83.33	119.33	3.5	5.40	6.83	10.33	3.67
14	Darabata_3	74.67	110.67	4.0	6.30	6.50	11.17	4.33
15	Babo_3	83.67	120.33	3.4	6.10	9.33	12.13	3.43
	lsd (0.05)	**1.79**	**1.75**	**ns**	**ns**	**ns**	**ns**	**ns**
	CV (%)	**1.35**	**0.91**	**21.32**	**19.76**	**26.61**	**15.00**	**38.01**

DF- Days to 50 % flowering; DFS- Days to 95 % fruit setting, FD- Fruit diameter, cm; FL- Fruit length, cm; TD- Tuber diameter, cm; TL- Tuber length, cm; RTY- Total tuber yield, kg/plot.

Principal Component Analysis

Principal component analysis showed that the first three components contributed about 94.36 % variation in the genotypes. In the first component, days to 50% flowering and days to 95% fruit setting has significant value while in the second PC (days to flowering) and 3rd PC (tuber length, tuber

diameter and fruit length) had significantly higher values (Table 5).

Table 4: Principal component analysis for the first three vectors

Agronomic traits	PRIN1	PRIN2	PRIN3
Days to 50 % flowering	0.717	0.650	-0.169
Days to 95 % fruit setting	0.677	-0.726	0.061
Fruit diameter, cm	0.013	0.059	0.141
Fruit length, cm	-0.039	0.114	0.367
Tuber diameter, cm	0.081	0.138	0.315
Tuber length, cm	0.073	0.066	0.844
Tuber yield, kg/4 m^2	-0.123	-0.103	-0.045
Eigen values	22.093	5.923	1.857
Percentage variance	69.787	18.709	5.865
Cumulative variance	69.787	88.496	94.361

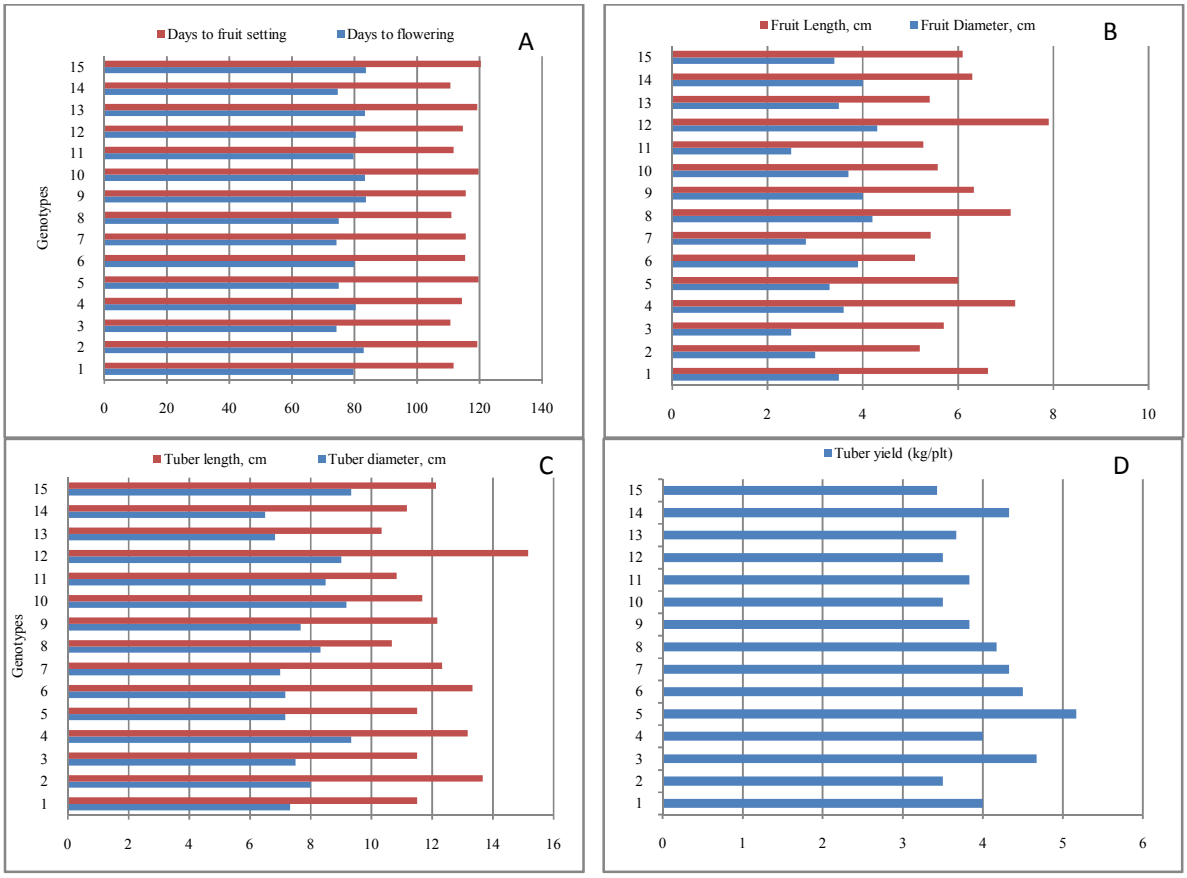

Figure 1: Histogram for mean values of days to flowering and days to fruit setting (A); fruit length and fruit diameter (B); tuber length and tuber diameter (C) and Tuber yield (D) for 15 genotypes of anchote grown in Nekemte in 2013 crop season

Phenotypic Correlation

Days to flowering and days to fruit setting are high significantly and positively correlated. Days to flowering is significantly but negatively correlated with tuber yield indicating that late flowering genotypes are less tuber yielder than early flowering types. Therefore early varieties are more important than the late flowering types (Table 6). Fruit diameter and fruit length are positively and significantly correlated hence it is possible to select genotypes with higher fruit diameter and fruit length at same time. Tuber diameter is negatively and highly correlated with tuber yield indicating genotypes with higher tuber diameter are less yielder and hence there is a need to make separate selection for the two traits. In all cases, tuber yield is negatively correlated with other agronomic traits hence there is a need to opt for other traits that are positively correlated with tuber yield for indirect selection for higher tuber yield.

Table 5: Correlation coefficients for the 7 agronomic traits of anchote genotypes grown at Nekemte campus in 2013 cropping season

Agronomic Traits	DFS	FD	FL	TD	TL	YD
DF	0.581*	0.184	-0.105	0.452	0.247	-0.650**
DFS		-0.008	-0.327	0.193	0.183	-0.422ns
FD			0.615**	0.111	0.246	-0.075
FL				0.392	0.317	-0.070
TD					0.359	-0.592**
TL						-0.144

** and ns indicates significant (P≤0.01) and non significant (P>0.05) respectively.

CONCLUSIONS

Root and vegetable crops are important in supplying balanced diet in small scale farming communities. Anchote is one of the most important root crops grown in western Ethiopia. Anchote dish is popular among restaurants and groceries as cultural food in the region. However, the supply is very limited due to lack of suitable varieties for small and large scale production. Hence the objective of the study was to evaluate 15 anchote landraces for root tuber yield and related agronomic traits at Nekemte. The varieties were arranged in randomized block design with three replications and grown in 2013. Data were recorded for DF, DFS, FL, FD, RL, RD and RTY. The analysis of variance indicated that the genotypes were highly significant different for DF and DFS. Genotypes were categorized as early, late and medium types for DF and DFS. Similarly, genotypes were varied for fruit diameter and fruit length though not significant. Eight genotypes viz. Haro_2, Ilfata_2, Jalale_1, Babo_1, Ilfata_1, Gute_1, Tinfa_4, and Darabata_3 had higher root tuber yield as compared to others and these genotypes will be further evaluated for stability over locations and years in the future.

Conflict of Interest

None declared.

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