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Effect of Flower Bud Removal on Root Quality of Anchote (*Coccinia abyssinica* (Lam.) Cogn.) Accessions at Bishoftu, Ethiopia

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ABSTRACT

Assimilate distribution in root and tuber crops to the reproductive parts affect the expected nutritional quality of the underground parts, tubers and/or roots. Regardless of this fact, anchote growers practically leave fruits to grow until the harvest of the roots, diverting the photosynthates. However, there is no research attempt made so far assess the effect of flower bud removal on nutritional quality of anchote root. Therefore this research was conducted at DZARC field in 2011/2012 with the objective of assessing the effect of flower bud removal on root mineral nutrient content of different anchote accessions. The experiment consisted of two factors vis-à-vis Factor A: anchote accessions (90801, 220563, 240407B, 240407G, 90802, 223090, and Kuwe) and Factor B: flower bud removal (with and without removal). A 2x7 factorial arrangement was laid with RCBD and replicated three times. Data pertaining to nutritional quality parameters of root were collected and analyzed using SAS statistical package with 9.2 versions (SAS 9.2 version Institute Inc., 2008). As per the results, interaction effect of accession and flower bud removal was significant (P<0.05) for percent dry matter content of roots and highest (23.18%) recorded on accession 223090 when the flower buds were removed. Anchote accessions significantly (P<0.01) differed with respect of root mineral nutrient content. The highest root protein (8.26%) and calcium (89.79 mg/100 g) content found in 220563 and 223090, respectively. Accession 223090 also contain highest magnesium (45.36 mg/100 g) compared to the rest. Except phosphorus and iron content, all mineral nutrients significantly (P<0.01) affected by flower bud removal. Absence of flower bud increased root crude protein, calcium and magnesium content by 5.22, 3.34 and 3.92 in percent, respectively. The study revealed that flower bud removal had a pronounced effect on root mineral nutrient content of anchote and accessions differed significantly for all quality parameters examined. In general, this research put imperative information pertinent to the influence of developing fruits on the main consumable part, the root.

Keywords: Anchote accessions, Flower bud removal, Mineral nutrient, Quality

INTRODUCTION

Anchote, the Afan Oromo name for *Coccinia abyssinica*, which is annual trailing vine belonging to the cucurbitaceous family grown for its tuberous root. The tender leaves are also widely consumed in growing areas [1]. *Coccinia abyssinica* is a member of the family cucurbitacea, a tuberous annual, with shoots having simple tendrils [2]. There are about ten species of *Coccinia* in Ethiopia; however, only *Coccinia abyssinica* is cultivated for human consumption and also for cattle feed.

Anchote is an endemic to the Western parts of Ethiopia and the cultivation widespread in the Western and Southwestern provinces of Wollega, Kaffa, Sidamo, and Illubabor, where other tuberous species of *Colocosia*, *Dioscorea* and *Musa* are also extensively cultivated [3]. In these provinces, anchote is cultivated at elevation varying from 1,300 m to 2,800 m above sea level where the rainfall ranges from 762 mm to 1,016 mm; it also occurs in the wild state in more arid regions [4]. The area covered in 1998/99 in East Wollega and West Wollega zones were 440.75 ha and 440 ha respectively [5].

Similar to other cucurbits anchote possess fruits with considerable size. The length of the fruits ranges from 5.00 to 9.03 cm, diameter ranges from 26.94 to 60.83 mm, and the fruit shape is heterogeneous; plum shaped, round, round oval, spherical and round elongated [6]. However, unlike most cucurbits anchote has tuberous root dominantly consumed by growers and this necessitates in raising hypothesis with respect the competition may be able to happen between fruits and the tuberous root.

Developing flowers and fruit are strong sinks for mineral nutrients, sugar and amino acids, and there is a corresponding decrease in the amounts available for the growth of other plant parts, sinks. Depending on the strength of the sinks, potato plants allocate assimilates to the developing fruit, tubers and other vegetative structures. Under conditions of assimilate limitation competition among sink organs is imperative. Pruning of reproductive parts allow assimilates to distribute to vegetative parts [7,8].

Since anchote have fruit and tuberous root parts, competition for assimilates might be aggressive. The issue is further pronounced because it produces large fruits at the expense of root growth and nutritional quality; the principal consumable part. However, to date, farmers are producing anchote without removing flower buds, and allowing fruits to grow until the tuberous root are harvested. In addition root mineral nutrient content of anchote accessions is different so that selecting accession/s with better mineral nutrient content in the tuberous root is important to consumers. Therefore this study was initiated to determine the effect of flower bud removal on root nutritional content of anchote and to select accession(s) best in mineral nutrient content.

RESEARCH METHODOLOGY

Description of the Experimental Site

The study was conducted at Bishoftu, Debre Zeit Agricultural Research Center (DZARC) research Site, 47 km east of Addis Ababa in the year 2011/2012 cropping season. The study area is located approximately 08°44' N latitudes and 38°58' E longitudes geographic coordinates with altitude of 1860 meters above sea level. The area receives an annual average rainfall of 851 mm and has mean minimum and maximum temperatures of 8.9°C and 24.3°C, respectively.

Experimental Material

Anchote accessions seven in number (Table 1) were obtained from Debre Zeit Agricultural Research Center (DZARC).

Table 1: Anchote accessions used in the experiment

Collection area			
Accession	**Region**	**Zone**	**District**
90801	Oromia	Horro GuduruWollega	Abbay Chomen
220563	Oromia	West Shoa	Bako Tibe
240407B	SNNPRS	Keficho Shekicho	Decha
240407G	SNNPRS	Keficho Shekicho	Decha
90802	Oromia	Horro GuduruWollega	Abbay Chomen
223090	Oromia	West Wollega	Gimbi
Kuwe	Oromia	East Wollega	Sibu Sire

Treatment and Experimental Design

The experiment consisted of two factors vis-à-vis Factor A: Anchote accessions (90801, 220563, 240407B, 240407G, 90802, 223090, and Kuwe) and Factor B: Flower bud removal (With and without removal). A 2x7 factorial arrangement was laid out using Randomized Complete Block Design (RCBD) and replicated three times.

Data Collected

The assessment for mineral nutrient content of roots (Percent dry matter, Crude Protein, Calcium, Phosphorus, Magnesium and Iron) was performed at soil and plant nutrition and horticultural laboratories found at DZARC.

Data Analysis

The collected data were checked for normality and meeting all ANOVA assumptions. Then data were subjected to the Analysis of Variance (ANOVA) using SAS statistical package with 9.2 versions (SAS 9.2 version Institute Inc., 2008). Least Significant Difference (LSD) was used to separate mean values of the treatments with significance level of 5%.

RESULT AND DISCUSSION

Percent Dry Matter Content of Roots

Data pertaining to the dry matter content of roots revealed that there was a significant (P<0.05) interaction effect between anchote accessions and flower bud removal treatment. Accordingly, the highest root dry matter content was found from anchote accession 223090 in which the flower buds were removed (23.18%) which however was at par with accession 240407 G wherein the flower bud removed (22.40%) (Figure 1). On the other hand, the lowest dry matter content was recorded from accession 90802 whose flower bud was not removed (18.32%).

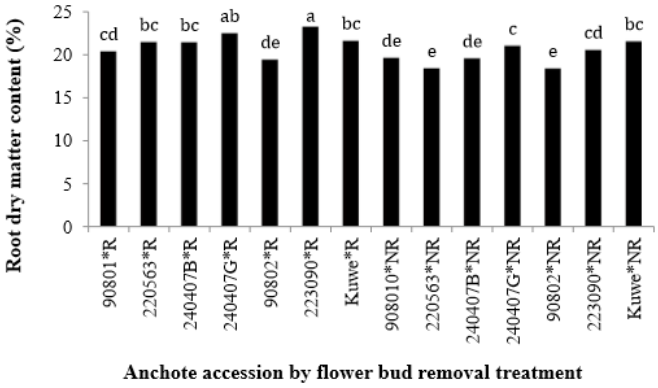

Figure 1: Interaction effects of accession and flower bud removal treatment on root dry matter content (%) of anchote in 2011/2012 at Bishoftu. Means followed by the same letter(s) irrespective of the accessions, flower bud removal alone had significantly influence the dry matter content.

However, the treatment influence was not equal for all accessions. The observed increase in dry matter content as a result of flower bud removal in different accessions might be due to the flow of ample amount of assimilates to the sink, which would have otherwise contributed for fruit development, and ultimately resulting in high dry matter content in roots of anchote. In parallel with this result, investigation on yam bean revealed that, there was a significant interaction between genotypes and sink-reproductive pruning on tuber dry mass content [7,8].

Crude Protein Content of Roots

With regard to crude protein content of roots, a highly significant (p<0.01) variation was observed due to accession and flower bud removal treatment. According to the results presented in Table 2, irrespective of the flower bud removal treatment, the maximum crude protein content was registered by accession 220563 (8.26%) which however was statically at par with accession kuwe (8.26%), 90802 (8.23%) and 90801 (7.99%) while the minimum was obtained from accession 240407B (6.75%) and no significant difference with accession 240407G (6.98%). The apparent variation in root protein content might be attributed to the inherent genetic variation among the accessions not only in terms of photosynthesis but also in the partitioning of dry matter. The result is in agreement with [9] on potato. Moreover, the present finding consolidates the fact that root crude protein content of anchote is higher than tubers of potato (3-6%), roots of cassava (1-2%) and corm of taro (2%) [10]. Regardless of anchote accession types, flower bud removal alone increase crude protein by 5.22% than the control (intact flower bud). In contrast to the usual result, protein content was negatively affected by flower bud removal on accession 90801. Probably, developing fruits do not have absolute priority over assimilates from the vegetative organs in this accession.

Table 2: Crude protein, calcium, phosphorus, magnesium and iron content of anchote roots are influenced by accessions and flower bud removal treatment.

	Crude Protein	Ca	P	Mg	Fe
	(%)	(mg/100 g)	(mg/100 g)	(mg/100 g)	(mg/100 g)
Accession					
90801	7.99a	50.78d	56.75e	20.69f	21.59c
220563	8.262a	25.85f	124.93b	34.86c	25.67b
240407B	6.75c	38.09e	91.83c	38.43b	8.44g
240407G	6.98bc	24.83f	124.07b	35.43b	13.29f
90802	8.23a	74.74c	214.17a	25.02d	15.74e
223090	7.13b	89.79a	67.83d	45.36a	17.49d
Kuwe	8.26a	80.98b	208.17a	22.42e	28.35a
LSD (0.05)	**0.3558**	**1.817**	**7.5047**	**0.745**	**0.4451**
Flower bud removal					
Removed	7.86a	55.94a	1126.95a	32.39a	18.63a
Not Removed	7.45b	54.07b	126.69a	31.12b	18.67a
LSD (0.05)	**0.1902**	**0.9712**	**4.0114**	**0.2379**	**0.3982**
CV (%)	**3.92**	**2.78**	**4.98**	**1.98**	**2.01**

Means followed by the same letter per column are not significantly different at p>0.05.

Calcium Content of Roots

Highly significant (p<0.01) variations were observed in respect of calcium content of roots among accessions considered in the study. Moreover, significant (p<0.05) differences were noticed as a result of flower bud removal treatment (Table 2). Irrespective of the flower bud removal treatment, the highest calcium content was found in accession 223090 (89.79 mg/100 g) followed by accession kuwe (80.98 mg/100 g). The difference among accessions in respect of calcium content might be attributed to the inherent genotypic difference in terms of utilizing calcium deposits for cell wall and cuticle layer in the tuberous roots. In coherence with the findings of the present study, a variation in terms of calcium content was observed among cultivars of sweet potato [11] and cassava [12]. Flower bud removal treatment alone imparted its influence on the calcium content of roots whereby flower bud removal increased calcium content by 3.34% over the control. Possibly, this could be associated with the high demand for calcium in fruits that contain seeds and hard skin thus draining the available calcium which otherwise would have been used for vegetative growth and underground sink formation.

Phosphorus Content of Roots

As per the findings of the present study (Table 1, Appendix), there was a highly significant (p<0.01) variation in respect to phosphorous content of roots attributable to the influence of accessions. On the other hand, there appeared statistically no significant (P<0.05) difference noticed which could be accounted to flower bud removal or its interaction with accessions. According to Table 2 the highest root phosphorus content was found in accession 90802 (214.12 mg/100 g) which was statically identical with that of accession *kuwe* (208.17 mg/100 g). The inherent genetic makeup might have resulted in the variation observed among accessions. In line with the present findings, [13] reported, sweet potato cultivars had differed in their phosphorus content.

Magnesium Content of Roots

Referring to Table 1 in appenedix, highly significant (p<0.01) variations were noticed in respect of root magnesium content as a function of accession and flower bud removal treatment. In spite of the flower bud removal treatment, the maximum magnesium content was found in accession 223090 (45.36 mg/100 g) followed by accession 240407B (38.43 mg/100 g) and 240407G (35.43 mg/100 g). Presumably, genotypic difference in terms of mobilizing magnesium and its incorporation in the formation of chlorophyll of leaves and root structures could be accountable for the vivid variation that appeared among accessions. This is in the same fashion with the work reported on potato [14]. Irrespective of the type of anchote accessions studied, flower bud removal significantly influenced the magnesium content and increase by 3.92%. The observed result entails that when there are more than one sink sites, such as fruits and roots, the available assimilate will be partitioned, the completion governing the extent of nutrient accumulation in these sites. Therefore, absence of strongly competing sink site (reproductive parts) other than roots would defiantly favour more magnesium deposition in the roots.

Iron content of roots

The analysis of root iron content revealed a highly significant ($p<0.01$) variation among anchote accessions studied. Based on the results presented in Table 2, root iron content ranged from 8.44 mg/100 g to 28.35 mg/100 g. The highest root iron content was recorded in accession kuwe (28.44 mg/100 g) followed by 220563 (25.67 mg/100 g). Perhaps, the inherent genotypic difference could be accountable for the observed variation in the iron content of anchote accessions. This result is in agreement with that of [6] who reported similar discrepancies among the anchote accessions for their iron content of roots.

CONCLUSION AND RECOMMENDATION

Root mineral nutrient content of anchote accessions was varied and the presence of developing fruits negatively affected most of the mineral nutrient examined. Irrespective of flower bud removal, accessions varied for the content of mineral nutrients studied. Maximum crude protein content was obtained from accession 220563 (8.26%) which however was statically identical with *kuwe* (8.26%), 90802 (8.23%) and 90801(7.99%). Root calcium content was registered as maximum for accession 223090 (89.79 mg/100 g) followed by *kuwe* (80.98 mg/100g) whereas accession 240407G (24.83 mg/10 0g) and 220563 (25.85 mg/100 g) were found minimum. Furthermore, root phosphorus content was highest in accession 90802 (214.12 mg/100 g) with no significant difference from *kuwe* (208.17 mg/100 g). Accession *kuwe* was found to have the highest (28.44 mg/10 g) root iron content while root magnesium content found to be highest in accession 223090 (45.36 mg/100 g).

Generally, this research showed the influence of flower bud removal on root quality of anchote accessions. In addition, accession *kuwe* had ideal root protein, calcium, phosphorus, and iron content as compared to the rest of the accessions and can be selected as best accession. Furthermore, accessions with good protein, calcium, phosphorus and magnesium content could be put forward as supporting evidence that anchote can be used in fast curing of bone fractures. However, as the study was conducted under irrigated condition, it would be wise to revisit the findings of the present study under rain-fed conditions to come up with sound recommendation. Furthermore it is better to assess the effect of flower bud removal on nutritional quality of anchote leaves.

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