Agricultural Journal 8 (6): 315-321, 2013
ISSN: 1816-9155

Effects of Location, Genotype and Ratooning on Chemical Composition of Sweetpotato [*Ipomea batatas* (L.) Lam] Vines and Quality Attributes of the Roots

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Abstract: Dual-purpose sweetpotato is gaining recognition as a food and fodder crop. The quality of the vines depends on several factors including genotype and environment. Cutting vines before root harvest can increase yields and fodder quality of vines. But, the effect on root quality has not been sufficiently investigated. This study was conducted to determine the effects of agro-ecology (n = 3), genotype (n = 7) and vines cuts (n = 3) on chemical composition and Metabolizable (ME) energy concentrations in vines and on farmers' preference of the roots. Dry Matter (DM) concentrations were lower in vines than in roots. It tended to be higher in ratoons than in vines cut only once at 160 DAP. Varieties differed significantly in the concentrations NDF (p = 0.0315), ADF (p = 0.026) and ADL (p = 0.0032) but not in CP and ME (p>0.05). Vine that were cut at 80 DAP had significantly lower concentrations of the fiber components (p<0.0001) and significantly higher concentrations of CP and ME than regrowth and intact vines cut at 160 DAP (p<0.0001). Ecozones differed significantly in contents of ADF (p = 0.026), ADL (0.0032) and ME (p = 0.0056). Cojoint analysis of preference scores revealed that variety accounted for 74.0,67.1 and 36.1% of the scores for texture, sweetness and color respective. Ratooning accounted for 5.2, 2.6 and 4.6% of the scores for texture, sweetness and color, respectively. Gender accounted for 20.8, 30.3 and 37.9% of the preference scores for texture, sweetness and color, respectively. The results proved that cutting vines twice at 80 days before and again at root harvest (160 DAP) improved vine quality without affecting root quality.

Key words: Sweetpotato, ecozones, ratooning, vines, quality

INTRODUCTION

Among the root and tuber crops sweetpotato (*Ipomea batatas* (L.) Lam) assumes special status because it provides opportunity for farmers who have limited land to grow food and fodder concurrently on the same piece of land (Nedunchezhiyan and Srinivasulu, 2002). It is one of the most efficient plants in terms of yields per unit of time (Nedunchezhiyan and Byju, 2005). The vines have high concentrations of protein (An *et al*., 2003) and digestibility (Foulkes *et al*., 1978; Nedunchezhiyan *et al*., 2012; Olorunnisomo, 2006). By Nigeria Olorunnisomo *et al*. (2006), estimated that with proper tillage and fertilizer application, sweetpotato biomass yield (kg ha^{-1}) could support two Tropical Livestock Units (TLU = 250 kg) for 1 year, showed that rational use of vines was economically feasible in Ethiopia. But biomass yields, chemical composition and nutritional attributes of the vines vary with genotype (An *et al*., 2003; Naskar and Nedunchezhiyan, 2009). Nasker and Neduchezhiyan (2009), also postulated that preferential partitioning of nutrients between root and vines could influence chemical composition of the two botanical fractions in sweetpotato cultivar. Because of differences in yield stability among genotypes, biomass productivity and related attributes vary across agro-ecological conditions (Haldavankar *et al*., 2009; Osiru *et al*., 2009). Premature harvesting of vines has been used to increase cumulative vine yields (Olorunnisomo, 2007; Ahmed *et al*., 2012). An *et al*. (2003), showed that the practice affected quality of the different vines cuts. This study was conducted to determine the effects of

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agro-ecological conditions, genotype and vines and ratooning on chemical composition and Metabolizable Energy (ME) concentrations in vines and on farmers' preference of the roots.

MATERIALS AND METHODS

Sweetpotato genotypes used in the study (cv 2000-040, 2002-154, 2002-155, Cacaerpedo, Kakamaga, Kwezikumwe, Mugande and NASPOT1) were selections from the national sweetpotato breeding program of Rwanda Agriculture Board (RAB) and non-descript ecotype found in with farmers (LOCALE). The agro-ecological niches were three districts in Eastern Province of Rwanda with shuttle but noticeable differences in altitude, rainfall, temperature, soil types and land use systems. The cultivars were planted on ridges at intra-row spacing of 20 cm between plants and inter-ridge spacing of 100 cm between ridges. The experiment was arranged in split-split plot randomized design with ecological zone (ecozones), genotype and vine cuts as main-plots, sub-plots, sub-subplots, respectively. It was implemented on 4 farms in each ecozone and three replicates on each farm. Vine cuts at 80 Days After Planting (DAP), 160 DAP and regrowth of vines harvested 80 DAP provided the samples from each farm and replicates for chemical analysis. A portion of the samples (known weights) from each plot was aired dried under shade and subsequently at 105°C for 48 h for DM determination. Another portion of the each sample was dried at 60°C for 48 h, ground to pass 2 mm screen and analyzed for OM/ash, Crude Protein (CP), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL) and Metabolizable Energy (ME). These analyses were conducted using Near-Infra-Spectroscopy (Corson *et al*., 1999) at International Livestock Research Institute (ILRI) laboratory.

RESULTS AND DISCUSSION

DM concentrations in vines reported in this study (Table 1) were similar to those reported in other studies (Muck *et al*., 1999; An *et al*., 2003; Lam and Ledin, 2004; Olorunnisomo, 2007; Naskar and Nedunchezhiyan, 2009). But, the DM contents in intact vines for cultivars 2000-040 and 2002-155 at Gatsibo and cultivar 2002-040 at Nyagatare were lower than expected (Table 1). The variances were likely to be associated analytical artifacts. It did not differ significantly among ecozones ($p = 0.3642$) but tended to be higher in vines from ratooned than intact crops ($p = 0.0681$). The tendency was expected because vine cuts at 80 DAP and their respective regrowths had more leaves than mature vines harvested at 160 DAP. Old vines loose leaves due to senescence (An *et al*., 2003). In sweet potato DM contents are higher in the leaf than in the stem fractions of the vines (Ishida *et al*., 2000; An *et al.*, 2003). Proportionately vines are more than stems (An *et al*., 2003). DM content tended to be higher in Rwamagana than in Nyagatare, than in Gatsibo, respectively.

Breeding for DM content in roots has been given emphasis because of it relationship with starch contents for food and industrial applications (Nedunchezhiyan *et al*., 2012), as well as taste preference (Tomlins *et al*., 2012). Compared to the range of values that have been reported (Brabet *et al*., 1998), the DM contents in roots in this study (Table 1) were moderate and similar to values reported by Shumbusa *et al*. (2010) and Laurie (2010). The significant difference among varieties ($p = 0.0422$) also tallied with findings by Irungu *et al*. (2002). Nevertheless mean DM contents were consistently higher in roots from Rwamagana, than in Gatsibo than in Nyagatare, respectively (Table 1).

Concentrations of detergent fiber components: NDF contents were within the range reported in other studies (An *et al*., 2003; Lam and Ledin, 2004; Olorunnisomo, 2007). It differed significantly among varieties ($p = 0.0315$) and between vine that were cut or not cut at 80 and 160 DAP ($p<0.0001$). The response to cutting and not cutting vines varied across ecozones ($p<0.0001$). NASPOT1, Mugande and Kakamega had lower NDF contents than all the other cultivars. The differences in NDF contents among sweetpotato genotypes were expected (Ishida *et al*., 2000; An *et al*., 2003). First, cuts of vines at 80 DAP had significantly lower NDF (316.0±2.9 g kg^{-1} DM) concentrations than vines cut at 160 DAP irrespective of whether they were first cuts at 160 DAP (337.0±2.3g kg^{-1} DM) or regrowth cut at 160 DAP (334.8 g kg^{-1} DM). Olorunnisomo (2007) reported similar trends in NDF contents with increasing intervals between vine cuts. The differences in the fiber contents among the vines cuts were small in Gatsibo and Nyagatare and it tended to be lower in the vine regrowth than in the first cuts at both 80 and 160 DAP (Table 2). The three locations did not differ significantly in NDF contents ($p = 0.3138$). But, in Rwamagana NDF contents were lower in first cuts at 80 DAP than in the first cuts at 160 DAP by approximately 180 g kg^{-1} DM (Table 2) and the interaction between cutting management and ecozone was highly significant ($p<0.0001$). The observation as attributed to unexpectedly low NDF content in 80 DAP vines cuts in Rwamagana (Table 2). Low fiber contents in forages have been associated with difference in altitude (Cermak *et al*., 2006). Rwamagana is located at higher altitude (1600 m a.s.l) than Nyagatare (1400 m a.s.l).

Table 1: Effects of location, genotype and ratooning on dry matter contents (g kg^{-1}) of sweetpotato vines and roots

		Vine		Root	
Eco-zone	Variety	Intact	Ratoon	Intact	Ratoon
Gatsibo	2000-040	35.6±1.1	172.5±82.4	313.5±23.1	262.6±48.8
	2002-154	117.0±28.3	100.7±65.6	133.2±115.1	136.5±118.4
	2002-155	55.2±12.1	163.1±80.7	200.8±51.4	202.9±35.2
	Cacaerpedo	92.2±39.5	142.7±12.1	241.8±71.4	238.5±80.2
	Kakamega	100.1±40.4	126.3±52.9	287.8±71.4	235.0±67.5
	Kwezikumwe	NA	NA	210.7±59.1	216.0±58.4
	Locale	129.8±29.9	141.9±35.7	213.0±19.5	202.2±44.2
	Mugande	113.1±42.0	149.3±35.7	258.8±82.6	288.3±89.1
	NASPOT1	78.5±40.5	126.2±25.9	249.8±34.8	256.9±66.1
District	Mean	94.0±39.5	132.9±45.6	229.6±81.2	226.5±83.2
Nyagatare	2000-040	91.1±8.1	115.9±5.1	142.7±36.2	121.1±26.9
	2002-154	118.8±16.1	128.0±14.0	187.8±32.5	196.2±18.1
	2002-155	129.0±14.4	145.2±11.8	171.7±61.0	183.6±33.4
	Cacaerpedo	128.7±13.5	152.0±32.6	174.3±54.0	152.9±46.0
	Kakamega	125.8±18.4	152.3±36.3	206.8±62.6	207.1±71.0
	Kwezikumwe	129.2±11.3	144.2±20.2	185.7±46.6	208.0±41.9
	Locale	116.6±15.3	136.6±24.3	182.9±31.2	175.8±35.0
	Mugande	109.2±25.6	130.9±36.0	210.5±54.7	220.4±55.1
	NASPOT1	110.6±13.3	136.2±34.4	190.0±25.8	203.8±37.1
District	Mean	119.6±18.5	140.7±29.0	187.7±48.7	191.1±51.4
Rwamagana	2000-040	NA	NA	NA	NA
	2002-154	152.5±44.0	160.7±37.9	222.7±77.4	248.8±161.5
	2002-155	173.5±64.8	161.5±27.6	248.6±60.0	234.4±48.8
	Cacaerpedo	160.9±47.8	153.9±31.9	281.8±106.4	260.4±88.3
	Kakamega	160.0±57.2	144.6±33.6	291.2±135.8	306.2±139.9
	Kwezikumwe	147.7±37.3	146.4±27.7	254.6±108.7	238.1±71.6
	Locale	184.7±5.6	161.3±10.5	223.4±66.9	210.3±11.1
	Mugande	150.4±39.2	152.9±26.2	245.2±97.6	305.0±120.7
	NASPOT1	156.2±50.8	158.9±40.6	320.9±130.6	290.5±140.9
District	Mean	157.8±44.8	154.3±30.4	266.4±104.4	266.9±109.6

Ecozones differed significantly in ADF ($p = 0.026$) and ADL ($p = 0.0032$) concentrations. Ratooned and intact vines also differed significantly in the contents of the fiber components ($p<0.0001$). The responses of genotypes to ratooning varied highly significantly across ecozones ($p<0.0001$). Vines from Rwamagna had significantly ($p<0.05$) higher ADF and ADL contents than in vines from Nyagatare. ADF and ADL contents in vines from Gatsibo were intermediate and not significantly different from the ADF concentrations in vines from Rwamagana and Nygatare ($p>0.05$). But, the ADL concentrations differed significant across the three ecozones (Table 2). Intact (246.4±2.2 g kg^{-1} DM) and ratooned vines harvested at 160 DAP (250.6±3.1 g kg^{-1} DM) had similar ($p>0.05$) ADF concentrations which were significantly ($p<0.05$) higher than the contents of this fiber component in vines harvested at 80 DAP (231.6±2.8 g kg^{-1} DM). Vine had higher ADL concentrations regrowth (67.3±2.0 g kg^{-1} DM) than intact 160 DAP vine cuts (61.5±1.4 g kg^{-1} DM) which also had significantly higher ADL concentrations than 80 DAP vines (47.8 g kg^{-1} DM). Variety had no significant effect on ADF ($p = 0.1474$) and ADL ($p = 0.2208$). The response to ratooning varied significantly with variety in ADL concentration. There was a strong tendency ($p = 0.0555$) for ADF contents also to vary across the sweetpotato genotypes. The magnitude of the differences between 160 DAP and 80 DAP vines wider in Rwamagana than in Gatsibo and Nyagatare (Table 2).

Vine ADF concentrations observed in this study was lower than expected from mature vines harvested 160 DAP (Lam and Ledin, 2004; Olorunnisomo, 2007). Therefore, the vines in this study qualified to be classified among the supreme quality forages by US quality standards (Ball *et al*., 2001). Locational difference was expected. Dasci and Comakli (2011) observed shuttle differences in ADF contents of forages that were associated with geographical aspects of rangelands in Turkey. Cermak *et al*. (2006) reported locational differences in NDF and ADF that was attributed to differences in altitudes of these locations. Rwamagana (1600 m a.s.l) and Gatsibo (1587 m a.s.l) are higher than Nyagatare (1400 m a.s.l) and it partially explained similarities in ADF contents in vines from Rwamagana and Gatsibo and their difference from Nyagatare. Lack differences among genotypes that we observed tallied the findings. The low levels of ADF in this study, can be attributed to low moisture conditions during the period of the study because drought conditions reduce growth, as well as the stimuli for cell wall formation in forages (Corbett, 2003). Maturity increases fibre contents in forages. Hence, the low ADF concentrations in 80 DAP vine harvests were expected.

Table 2: Effect of location, variety and ratooning on contents (g kg^{-1} DM) of Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL) and crude protein of sweetpotato vines

		Gatsibo				Nyagatare			
Chemical	Variety	160D intact	160D ratoon	80D ratoon	Variety mean	160D intact	160D ratoon	80D ratoon	Variety mean
NDF	154	349.9±11.3	317.8±21.0	354.8±17.1	340.8±9.7	339.7±9.90	306.0±17.1	324.8±21.0	323.5±9.7
	155	327.9±12.1	352.5±17.2	338.3±12.1	339.6±8.1	330.9±8.20	294.5±17.1	344.6±14.8	323.2±8.1
	CAC	347.0±14.8	339.8±13.2	342.7±12.1	343.2±7.7	335.4±8.50	331.0±11.2	321.5±9.80	329.4±5.8
	KAK	330.0±13.2	329.3±17.1	316.6±12.1	325.3±8.2	318.7±8.20	281.0±17.1	332.3±9.40	311.0±7.2
	KWE	333.6±12.1	334.0±21.0	346.8±12.1	338.1±9.0	332.2±8.90	336.9±12.1	346.7±9.80	338.4±6.1
	MUG	333.6±13.2	312.8±12.1	330.1±12.1	325.5±7.2	321.7±9.30	328.1±12.1	325.1±9.30	324.9±6.0
	NAS	325.2±12.0	323.8±12.0	312.4±13.2	320.5±7.2	319.1±9.80	325.4±11.2	306.7±9.80	317.2±6.0
	Mean	335.3±4.80	330.0±6.20	334.5±4.90	333.3±3.1	328.3±3.40	314.7±5.40	328.8±4.80	323.9±2.8
ADF	154	246.1±10.3	241.3±19.5	250.2±15.8	245.8±9.0	243.5±9.20	215.2±15.9	228.4±19.4	245.8±9.0
	155	244.6±11.2	257.3±15.8	245.7±11.2	249.2±7.4	237.2±7.60	214.3±15.9	256.0±13.8	249.2±7.4
	CAC	246.4±13.8	233.9±12.2	238.9±11.2	239.7±7.2	241.1±7.90	239.4±10.3	226.6±9.10	239.7±7.2
	KAK	235.5±12.2	236.5±16.0	230.6±11.2	234.2±7.7	231.4±7.60	206.3±15.9	247.6±8.70	234.2±7.7
	KWE	237.8±11.2	235.0±19.5	249.0±11.2	240.6±8.4	243.4±8.30	242.6±11.2	255.9±9.10	240.6±8.4
	MUG	244.9±12.3	216.3±11.2	233.6±11.2	231.6±6.7	232.4±8.60	237.8±11.2	234.0±8.60	231.6±6.7
	NAS	234.0±11.2	283.0±11.2	231.2±12.2	234.8±9.1	240.5±10.3	237.9±9.10	237.1±9.50	249.4±6.6
	Mean	241.3±4.40	243.3±5.80	239.9±4.50	241.5±2.8	237.7±3.10	228.0±5.00	240.9±4.40	235.5±2.4
ADL	154	60.2±6.20	51.6±11.7	50.0±9.50	54.0±5.4	54.0±5.50	47.1±9.60	39.1±11.7	46.7±5.4
	155	60.0±6.70	76.2±9.50	56.0±6.70	64.0±4.5	56.6±4.60	58.7±9.60	53.8±8.30	56.4±4.5
	CAC	61.9±8.30	51.8±7.40	53.0±6.70	55.6±4.4	57.7±4.80	51.6±6.20	45.3±5.50	51.5±3.2
	KAK	59.0±7.40	53.8±9.60	48.0±6.80	53.6±4.6	51.7±4.60	41.3±9.60	48.7±5.30	46.9±4.0
	KWE	52.1±6.80	59.7±11.7	53.4±6.70	55.1±5.1	53.7±5.00	60.7±6.70	49.6±5.50	54.7±3.4
	MUG	57.7±7.40	49.9±6.70	46.2±6.70	51.3±4.0	55.2±5.20	53.6±6.70	47.3±5.20	52.0±3.3
	NAS	52.1±6.70	101.7±6.70	52.1±6.70	8.4±4.0	54.8±5.50	57.3±6.20	39.7±5.50	50.6±3.3
	Mean	57.6±2.60	63.5±3.50	51.2±2.70	57.4±1.7	54.8±1.90	52.9±3.00	46.1±2.60	51.3±1.5

		Rwamagana				
Chemical	Variety	160D intact	160D ratoon	80D ratoon	Variety mean	Overall mean
NFD	154	352.3±9.40	360.5±22.4	269.5±33.6	326.3±12.5	330.2±6.1
	155	348.5±8.70	347.8±13.4	296.1±13.4	333.3±6.80	332.1±4.4
	CAC	326.5±9.40	376.6±21.8	298.1±9.40	334.4±8.20	335.6±4.2
	KAK	351.3±9.80	372.3±13.4	288.7±12.5	337.7±6.80	324.5±4.2
	KWE	350.1±8.90	363.8±10.5	287.0±8.80	333.6±5.40	336.8±4.0
	MUG	369.4±12.4	343.4±10.5	280.5±9.80	331.0±6.20	327.1±3.7
	NAS	332.0±9.70	348.5±13.4	271.0±9.20	318.0±6.10	318.5±3.7
	Mean	347.5±3.60	359.8±5.70	284.6±5.60	330.6±2.90	
ADF	154	273.4±8.60	279.8±19.4	196.1±27.6	249.8±11.5	241.5±5.7
	155	267.0±7.60	269.4±12.2	225.9±12.2	254.1±6.30	246.4±4.1
	CAC	244.6±8.60	284.2±19.4	210.3±8.60	246.4±7.60	240.6±3.9
	KAK	262.8±9.40	302.0±12.2	243.5±11.2	269.4±6.30	244.0±3.9
	KWE	258.8±8.20	280.3±9.70	215.2±7.90	251.4±5.00	246.5±3.7
	MUG	270.7±11.2	262.0±9.70	203.1±9.10	245.3±5.80	237.2±3.4
	NAS	248.2±8.70	279.8±12.2	201.5±8.00	243.2±5.60	243.4±3.4
	Mean	260.8±3.40	279.6±5.30	213.6±5.20	251.4±2.70	
ADL	154	79.4±5.20	82.7±11.7	41.8±16.6	68.0±6.90	56.2±3.4
	155	72.2±4.60	80.6±7.40	47.4±7.40	66.8±3.80	62.4±2.5
	CAC	68.1±5.20	86.6±11.7	41.6±5.20	65.4±4.60	57.5±2.4
	KAK	73.9±5.50	95.7±7.40	64.6±6.70	78.1±3.80	59.5±2.4
	KWE	73.8±5.10	84.8±6.00	45.0±4.80	67.9±3.00	59.2±2.2
	MUG	73.0±6.70	71.7±5.80	41.4±5.50	62.0±3.50	55.1±2.1
	NAS	66.5±5.20	94.2±7.40	47.7±4.80	67.1±3.40	62.1±2.1
	Mean	72.4±2.00	85.2±3.20	46.1±3.30	67.9±1.60	

Higher concentrations in vine regrowth harvested at 160 DAP was not expected because they were essentially the same age with 80 DAP vine cuts. This could be partially explained by the accumulation of hemicellulose that is associated with rapid forage growth (Campos *et al*., 2013).

Crude protein and metabolizable energy concentrations: Unlike Naskar and Nedunchezhiyan (2009), researchers did not observe significant differences in CP contents among the variety (p = 6504). Irungu *et al*. (2002), also observed no difference in vine CP contents when they compare 4 genotypes selected for fodder production. However, a critical review of data that Naskar and Nedunchezhiyan (2009) reported suggested that there was inadequate evidence to prove that breeding for root or vine production was associated with preferential partitioning of nitrogen between roots and vine. It could, therefore be associated with phenological differences among sweetpotato genotypes. The cultivars in this study were selected based on the same criteria including age at maturity. Hence, they were not likely to be phenologically different. Location also did not affect CP contents ($p = 0.5684$). But, it was significantly affected by the ratooning ($p<0.0001$). The effect of ratooning did not depend on the variety ($p = 0.5277$) but varied significantly with location ($p<0.0001$). Vine cuts at 80 DAP had significantly the highest CP content (208.7±2.8 g kg^{-1} DM) followed by the vine regrowth harvested at 160 DAP (200.8±3.1 g kg^{-1} DM) and vines from intact plots (193.1±2.2 g kg^{-1} DM). This was expected because CP concentration in forages decline with advancing maturity. But in Gatsibo and Nyagatare, the CP contents tended to be higher in vines cuts at 160 DAP, though the difference was small and not consistent across varieties. In Rwamagana the CP content in vines cut at 80 DAP were overwhelmingly higher than in other cuts (Table 3).

Metabolizable energy contents in this study were similar to values reported in forages in Rwanda (Mutimura *et al*., 2013). The energy contents varied significantly across ecozones ($p = 0.0012$) and ratooning regimes. The difference among varieties and their interactions with treatment and locations were not significant ($p>0.05$). ME concentration was significantly lower in vines from Rwamagana than in vines from Gatsibo and Nyagatare (Table 3). But, the vines from latter two ecozones did not differ significantly ($p>0.05$). This was associated with higher ADF and ADL concentrations in vines from Rwanda. ADF and lignin contents are adversely important attributes of forage quality (quote).

The first vine cuts (80 DAP) had the highest and significantly different ME concentration (8.0±0.08 MJ ME kg^{-1} DM), followed by the vines cut once at 160 DAP (7.3±0.06 MJ ME kg^{-1} DM) which was significantly higher than ME contents in second ratoons cut at 160 DAP (6.9 MJ ME kg^{-1} DM).

Farmers' perceptions of root quality: Conjoint analysis revealed that texture (74%) and taste (67%) were more important than color (6%) in determining farmers' choice

Table 3: Effect of location, genotype and ratooning on contents of crude protein (g kg^{-1} DM) and metabolizable energy (MJ kg^{-1} DM) in sweetpotato vines

		Gatsibo				Nyagatare			
Chemical	Variety	160D intact	160D ratoon	80D ratoon	Variety mean	160D intact	160D ratoon	80D ratoon	Variety mean
CP	154	176.8±10.6	203.2±19.5	175.0±15.9	202.6±3.80	180.0±9.60	219.8±16.1	186.6±19.5	195.5±9.30
	155	201.0±11.4	203.3±15.9	193.2±11.5	199.1±7.90	186.8±8.10	238.8±16.1	186.0±14.0	203.9±8.00
	CAC	199.3±14.0	200.6±12.5	197.4±11.5	199.1±7.70	197.9±8.40	204.6±10.6	207.8±9.50	203.5±6.00
	KAK	207.0±12.5	201.7±16.1	209.2±11.5	206.0±8.10	210.1±8.00	237.5±16.1	199.0±9.10	215.5±7.10
	KWE	198.6±11.5	211.9.±19.5	189.5±11.4	200.0±8.80	196.2±8.70	200.9±11.5	192.0±9.50	196.4±6.20
	MUG	199.9±12.6	212.2±11.5	194.1±11.4	202.1±7.20	209.4±9.00	209.9±11.4	201.7±9.00	207.0±6.20
	NAS	200.6±11.4	194.1±11.4	205.6±12.5	200.1±7.20	202.3±9.50	198.1±10.6	204.7±9.50	201.7±6.20
	Mean	197.6±4.50	203.8±5.80	194.9±4.60	198.8±3.00	197.5±3.30	215.7±5.10	196.8±4.50	203.3±2.60
ME	154	8.3±0.30	7.5±0.60	8.9±0.49	8.3±0.28	8.4±0.28	7.4±0.49	8.5±0.60	8.1±0.28
	155	7.2±0.35	6.6±0.49	7.9±0.35	7.2±0.23	7.6±0.24	6.5±0.49	8.1±0.42	7.4±0.23
	CAC	7.3±0.42	7.5±0.38	8.0±0.35	7.6±0.22	7.2±0.25	7.5±0.32	8.1±0.28	7.6±0.17
	KAK	7.3±0.38	6.9±0.49	8.1±0.35	7.4±0.24	7.3±0.24	7.5±0.49	8.1±0.27	7.6±0.20
	KWE	7.7±0.35	6.9±0.60	8.2±0.35	7.6±0.26	7.6±0.26	7.2±0.05	8.3±0.26	7.7±0.17
	MUG	7.5±0.38	0.4±0.35	8.5±0.35	7.8±0.21	7.3±0.27	7.3±0.28	8.4±0.28	7.7±0.17
	NAS	7.5±0.35	7.0±0.35	8.0±0.38	7.4±0.21	7.4±0.28	7.3±0.32	8.4±0.24	7.7±0.17
	Mean	7.5±0.14	7.1±0.18	8.2±0.14	7.6±0.09	7.6±0.10	7.2±0.15	8.3±0.13	7.6±0.08

		Rwamagana				
Chemical	Variety	160D intact	160D ratoon	80D ratoon	Variety mean	Overall mean
CP	154	181.6±9.00	168.4±19.5	259.6±27.6	203.±11.80	194.6±5.90
	155	184.7±8.10	190.7±12.5	223.7±12.5	200.7±6.90	201.2±4.40
	CAC	202.9±9.00	178.8±19.5	229.4±9.00	203.7±8.10	202.1±4.20
	KAK	179.7±9.50	172.0±12.5	237.2±11.5	196.3±6.90	205.9±4.20
	KWE	179.0±8.70	187.5±10.0	213.1±8.40	193.2±5.70	196.5±4.00
	MUG	163.9±11.5	194.9±10.0	242.6±9.50	200.5±6.40	203.2±3.80
	NAS	197.5±9.10	187.8±12.5	232.8±8.50	206.0±6.30	202.6±3.80
	Mean	184.2±3.20	182.9±5.40	234.5±5.30	200.5±2.90	
ME	154	6.5±0.27	6.5±0.60	7.2±0.85	6.7±0.36	7.7±0.18
	155	7.0±0.24	6.3±0.38	7.6±0.38	6.9±0.20	7.1±0.13
	CAC	6.5±0.27	6.4±0.60	7.7±0.25	6.8±0.24	7.3±0.12
	KAK	6.8±0.28	6.1±0.38	7.1±0.35	6.6±0.20	7.3±0.12
	KWE	7.1±0.26	6.2±0.30	7.8±0.25	7.1±0.16	7.4±0.11
	MUG	7.4±0.35	6.9±0.30	7.6±0.28	7.2±0.18	7.5±0.11
	NAS	7.0±0.27	0.8±0.38	7.8±0.25	6.9±0.18	7.3±0.11
	Mean	6.9±0.10	6.3±0.16	7.5±0.16	6.9±0.08	

Table 4: Effects of variety, ratooning and gender on farmers perceptions of sweetpotato root quality

Criterion	Items	Color	Sweetness	Texture
Intercept	Intercept	3.7628	2.81894	2.2705
Variety	2000-040	-0.5727	0.83100	-2.2515
	2002-154	0.1149	0.01170	0.1735
	2002-155	0.0716	-0.51460	0.2722
	Cacaerpedo	0.1149	1.15780	0.1735
	Kakamega	-0.0368	0.50820	0.5190
	Kwezikumwe	-0.0368	-0.20830	0.5744
	Local	0.1149	-0.48600	0.1735
	Mugande	0.1149	-0.25860	0.1735
	Naspot1	0.1149	-0.39330	0.1920
Ratooning	Ratooned	-0.0434	-0.03230	0.0987
	Intact	0.0434	0.03230	-0.0987
Gender	Women	-0.5666	0.37910	0.3966
	Men	0.5666	-0.37910	-0.3966
Importance (% utility range)	Variety	36.0510	67.02500	74.0460
	Ratooning	4.5460	2.59000	5.1720
	Gender	59.4040	30.38400	20.7820
ANOVA	Adj R^2	0.3795	0.46340	0.3040
	p-value	<0.0001	<0.00010	<0.0001

of varieties (Table 4). Gender was more important than taste and texture in influences the appreciation of color in sweet potato roots. Cutting vines before root harvest at maturity had relatively very little impact of the quality attributes of the roots.

Cultivar 2000-040 had the best (least utility score) for color followed by Kakamega and Kwezikumwe, 2000-155. Cacaerpedo and Kakamega were not as sweet as other varieties.

CONCLUSION

Dry matter contents, texture and taste of the roots were important attributes in variety development for food and fodder production in Rwanda. All the genotypes were equally suitable sources of protein and energy for ruminant livestock. However, the vines would requirement more supplements for energy in Rwamagana than in Gatsibo and Nygatare.

ACKNOWLEDGEMENTS

This study was supported by the Bill and Melinda Gates Foundation (BMGF) through Sweetpotato Action Security and Health in Africa (SASHA) project. The study was implemented through the BMGF funded East Africa Dairy Development (EADD) project. The University of Nairobi and Rwanda Agricultural Board supported by providing Supervision. The International Livestock Research Institute provided support in feed analysis using Near Infrared Spectroscopy. The Animal and Plant Nutrition Laboratory of the Rwanda Agricultural Board, Southern Zone Division provided support in soil analysis.

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