NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 50 Number 1, April 2019. Pp.1-9
Available online at: http://www.ajol.info/index.php/naj

EFFECT OF VINE HARVESTING REGIMES ON ROOT PROXIMATE COMPOSITION OF THREE SWEETPOTATO VARIETIES

[1]Okunade A.F., [2]Alfonso O.C., [2]Afuape S.O., [2]Abimbola O.O., [2]Salawu I.A.
[1]Cocoa Research Institute of Nigeria, Idi-Ishin, Oyo State, Nigeria
[2]National Root Crops Research Institute, Iresi sub-Station, PMB 2002, Osogbo, Osun State, Nigeria
Corresponding Authors' email: solomonafuape@yahoo.com

ABSTRACT
A common practice among sweetpotato farmers is the pruning of vines for sale in a field cultivated for root production. While the effects of such practice on root and shoot yields have been extensively investigated, little or no information is available on the effect of the practice on nutritional (proximate) composition of the fresh roots produced. To generate such important information to adequately advise the many farmers that engage in such practice, an experiment was conducted using three popular sweetpotato varieties and four cutting regimes (0, 6, 8 and 10 weeks after planting (WAP). All the normal agronomic practices were observed to ensure adequate plant growth. The three varieties, four pruning regimes and their interactions showed significant ($p<0.05$) differences for each proximate composition. While pruning led to reduction in root dry matter and carbohydrate contents in Ex-Igbariam and King J varieties, both nutritional components were enhanced by pruning in the Mother's Delight variety. However, among the pruning regimes, clear trend of increasing root dry matter and carbohydrate contents were observed in King J as the weeks after planting increased. Root carbohydrate of Mother's Delight reduced as pruning was delayed. Early or no pruning favoured root crude protein accumulation in Ex-Igbariam. In King J and Mother's Delight, late vine pruning was better for crude protein. The results for ash, crude fibre and fat contents, the relationships among the root proximate content, and the best time to prune each popular variety to achieve higher content of each proximate composition are discussed in the paper.

Keywords: Sweetpotato, vine pruning regime, proximate composition, and correlation

Introduction

Sweetpotato is an important food security crop in many tropical countries. It is widely cultivated in many tropical countries, especially sub-Sahara Africa and Nigeria where it has outpaced the growth rate of other staples (Kapinga *et al.,* 2007 and CIP 2017). It is a highly nutritious crop with its tuberous roots and leaves serving as excellent sources of carbohydrate, protein, iron, vitamins A, C and fibre (Smart and Simmonds, 1995). Apart from its role as a food security crop, the health benefits it gives, especially the orange-fleshed sweetpotato (OFSP) type with its enormous quantity of β-carotene content, have made it a good candidate for the prevention of malnutrition (hidden hunger) among the rural and urban underprivileged populace. The increasing recognition of sweetpotato as a nutritious food for humans and animals has resulted in intensified efforts to enhance its production and consumption in recent decades (Yamakawa and Yoshimoto, 2002). One major constraint to sweetpotato root production and its use as fodder crop is the unavailability of the vines at critical periods of need. Most of the smallholder farmers who are the main producers are often unable to keep the vines over prolonged dry season. The farmers that are able to conserve their vines therefore target early cultivation to take economic advantage of the period of scarcity of roots and vines for sale. They repeatedly prune vines for sale and later harvest the roots for the early-season market. According to Leon-Velarde (2000), sweetpotato allows a low number of toppings without significantly affecting tuberous root yields. Most reported studies have focused on the effect of vine pruning on root and vine yields. This is often so because the quantity of food produced has often been considered more important than food quality. However, with the growing understanding of the role of nutrition on the state of human health, it is becoming clear that high food quality is as important as food quantity. Nwinyi (1992), Mohammed *et al*. (2012) and Aniekwe (2014) all reported that pruning sweetpotato vines significantly reduced root yield. Kiozya *et al*. (2001) and Mohammed *et al*. (2012) noted in their findings that harvesting sweetpotato vines at early and active stages of vegetative growth drastically reduced fresh tuberous root yield, dry tuberous root yield, the number of tuberous roots, shoot fresh yield, and shoot dry matter yield. Olorunnisomo (2007), in his work on sweetpotato forage, showed that time of pruning sweetpotato vine had significant effects on forage dry matter content and protein content. While effect of time of pruning sweetpotato vines on fresh root and shoot yields had been studied, information on the effect of time of vine pruning on sweetpotato root proximate composition had been scarce. Therefore, the main objective of this study was to determine the effect of harvesting of sweetpotato vines at different plant age (weeks after planting - WAP) on proximate composition of the fresh roots of popular sweetpotato varieties.

Materials and methods

Field experiment

The experiment was carried out on the experimental field of the National Root Crops Research Institute, Iresi Sub-station, Osun State. Three varieties of sweetpotato were used in the study namely, Ex-Igbariam, King J. and Mothers' Delight. King J and Mothers' Delight are orange-fleshed sweetpotato types while Ex-Igbariam has yellow flesh. The vines of each variety was pruned once, at 6, 8 and 10 weeks after planting, and a control of zero (no) vine pruning. The experiment was laid out in a 3 (variety) X 4 (vine pruning regime) factorial fashion in Randomised Complete Block Design (RCBD). Pruned vines were cut 20 cm from the ground, and each vine pruning regime was carried out on each of the three varieties such that a treatment combination of a variety and a pruning regime occupied a plot. The experimental field contained 12 plots with 3 replicates making 36 plots altogether. Apart from the variable factors of time of vine pruning and variety, all the plots on the experimental field received same agronomic practices. Fresh roots were harvested at 16 weeks after planting from which three approximately 0.5 kg roots were randomly selected from each plot (treatment combination) and immediately sent for laboratory analysis.

Root samples were harvested from the treatment combinations presented thus:

Ex-Igbariam roots from control plot (no vines pruned till maturity)

Ex- Igbariam roots from plots with pruned vines at 6 WAP

Ex-Igbariam roots from plots with pruned vines at 8 WAP

Ex-Igbariam roots from plots with pruned vines at 10 WAP

King-J roots from control plot (no vines pruned till maturity)

King-J roots from plots with pruned vines at 6 WAP

King-J roots from plots with pruned vines at 8 WAP

King-J roots from plots with pruned vines at 10 WAP

Mothers' Delight roots from control plot (no vines pruned till maturity)

Mothers' Delight roots from plots with pruned vines at 6 WAP

Mothers' Delight roots from plots with pruned vines at 8 WAP

Mothers' Delight roots from plots with pruned vines at 10 WAP

Proximate analysis

Proximate analysis was carried out at Human Nutrition Laboratory of the University of Ibadan, Nigeria. All analyses were performed in triplicates to determine dry matter content, carbohydrate, crude protein, crude fat, ash and fibre contents on all the samples using standard methods of Association of Official Analytical Chemist (2002).

Statistical analysis

The results from proximate analysis were subjected to Analysis of Variance (ANOVA) using a two-factor in CRD model to estimate the statistical significance of the effect of vine pruning regimes, varieties, as well as the interaction of the two factors on proximate composition of the sweetpotato root samples. Means of the main factors and their interactions were separated using Fisher's LSD at 5% probability. Pearson correlation coefficient analysis was also carried out to study the relationships among the proximate composition variables.

Results and Discussion

Variability among sweetpotato varieties, vine harvesting regimes and their interactions for root proximate composition

Table 1 presents the mean squares of the analysis of variance performed on the proximate composition of the root samples. All the proximate composition (carbohydrate, crude protein, fat, crude fibre and ash) showed that the three varieties, the four vine pruning regimes as well as their interactions were all significantly different ($p<0.001$) from one another. The differential response of varieties is not unexpected as the varieties used had different characteristics. Mother's Delight is a deep orange-fleshed variety with high beta-carotene content, King J is light orange-fleshed with moderate beta-carotene, while Ex-Igbariam is yellow-fleshed with low beta-carotene. Beta-carotene content has been known to exhibit negative correlation with dry matter (Afuape *et al*., 2014). The defoliation caused to the stands of each variety by vine pruning will interfere with the production of assimilates through photosynthesis. Depending on the phenological stage of development of the crop at which the defoliation occurred, accumulation of new assimilates and the remobilization of sequestered macro molecules will be expected to be differentially influenced by time of vine pruning.

Effect of time of vine pruning on proximate composition of sweetpotato varieties

Much emphasis has been placed on the development of sweetpotato varieties for root yield and disease resistance in the past. This has led to the development and release of high yielding and sweetpotato virus disease resistant varieties to farmers. Presently, research focus is gradually shifting to nutritional composition of available cultivars, and how farmers' practices affect the bio-chemical composition of these farmer-preferred varieties. The effect of the common practice of vine-pruning on dry matter, carbohydrate content, crude protein, fibre content, ash content and fat content were studied.

Dry matter content (DMC): It is an important trait that enhances acceptability of sweetpotato for consumptionand processing in sub-Sahara Africa (Mok *et al*., 1997; Mwanga *et.al*., 2007; Cervantes-Flores *et al.*, 2010). In all the sweetpotato samples analysed, dry matter content ranged from 21.35% (in King J pruned at 6 WAP) to 40.10% (in Mother's Delight pruned at 8 WAP) (Table 2). Results showed that pruning regimes at 0, 6, 8 and 10 WAP all significantly affect dry matter content of all the three varieties in different ways. In Ex-Igbariam (yellow-fleshed root), pruning led to reduction in root DMC as roots from non-pruned stands had significantly ($p<0.05$) higher DMC (37.67%) compared to the roots of pruned stands (33.11% for 6 WAP; 35.11% for 8 WAP; 26.71% for 10 WAP). In King J variety, the highest DMC of 37.45% was observed in roots of plants pruned at 10 WAP, while the lowest root DMC (21.35%) was recorded at 6 WAP. For King-J, either no pruning or late vine harvesting at 10 WAP will enhance high root DMC at harvest. For the Mother's Delight variety, the highest root DMC of 40.10% was observed in stands of Mother's Delight variety pruned at 8 WAP. In fact, roots of all pruned stands of Mother's Delight had significantly higher DMC compared to non-pruned stands (control). An important observed trend is that if vines must be pruned, late pruning at 8 WAP (for Ex-Igbariam and Mother's Delight) to 10 WAP (for King J) ensures high dry matter accumulation in the roots at harvest.

Carbohydrate content (CHO): In all the samples, carbohydrate composition ranged from 19.66% (in King J at 6 WAP) to 37.61% (in Mother's Delight at 6 WAP) (Table 3). This observation is within FAO Corporate Document Repository carbohydrate range but slightly against Lyimo *et al*., (2010) who reported 23.91 – 41.46% carbohydrate content in root samples of six different varieties. For root CHO, Ex-Igbariam and King J, two varieties with high dry matter contents, had highest root CHO of 34.43% and 33.85%, respectively. These were significantly higher than the root CHO composition from all levels of pruned stands. Only Mother's Delight, a typically soft variety with low dry matter, had root CHO from pruned stands (37.61% at 6 WAP; 36.69% at 8 WAP; 33.26% at 10 WAP, respectively) significantly higher than root CHO from non-pruned stands (20.03%). It is clear that, while pruning reduces root CHO in hard sweetpotato types, it enhances CHO accumulation in roots of soft Mother's Delight. However, in Ex-Igbariam and Mother's Delight, the earlier (6 – 8 WAP) pruning was done, the better for root CHO accumulation at harvest (16 WAP). This could only be so if the plant is able to regrow quickly after early pruning and initiate root CHO accumulation afterwards. There are no data to show the onset and rate of CHO accumulation after pruning. As for King J, it's very vigorous nature suggests that by 10 WAP, it must have accumulated high quantity of root CHO such that pruning has little effect on it afterwards. Having treatments that can either increase or decrease CHO in sweetpotato roots is a good one as it increases the spectre of utilization for the crop.

Crude Protein (CP): Crude protein content in all the varieties ranged between 0.83% (in Ex_Igbariam at 8 WAP) to 2.09% (in Mother's Delight at 8 WAP). This range is close to 1.00 - 2.40% range for protein content of sweetpotato reported by FAO (2017). As showed by the results, Mother's Delight had the highest crude protein content across all pruning regimes of 1.47%, while King J had the least (1.36%). Across varieties, pruning at 10 WAP had the highest mean CP of 1.57%, while the least CP was recorded by pruning at 6 WAP (1.22%). In all the varieties, pruning regime influenced CP. Except in Ex-Igbariam where there was no difference between root CP from non-pruned stands (1.78%) and pruning at 6 WAP which had the highest root CP of 1.79%, other varieties (which are also the orange-fleshed types) had mean root CP from plants pruned late (1.75% at 10 WAP for King J, and 2.09% at 8 WAP for Mother's Delight). Generally, late vine pruning (10 WAP for King J with CP of 1.75%, and 8-10 WAP for Mother's Delight with CP of 2.09 and 1.70 respectively) enhanced CP content at maturity (16 WAP) as against highest CP accumulation at 6 WAP early pruning stage in Ex-Igbariam. Since the orange-flesh colour is correlated with beta-carotene content in sweetpotato (Burgos *et al*., 2009), beta-carotene content may have a relationship with root CP accumulation. This relationship needs to be further studied.

Fat content: The fat content in the three varieties had a range of 0.14% (Ex-Igbariam at 6 WAP) to 0.50% (Ex-Igbariam at 10 WAP) (Table 5). This range is very low, though it falls within the range of 0.03 – 0.95% observed by Lyimo. et al., (2010). The range of 1.02 – 1.72% and 1.8 - 6.4% reported by Omodamiro et al. (2013) and FAO (2017) respectively were higher. This was probably because of the high number of genotypes involved in their works. Pruning regimes across varieties were significantly different in their influence on fat content accumulation, with 0 WAP having the highest fat content of 0.41%, and 10 WAP with 0.23%. Also, across pruning regime, King J had the highest mean fat content of 0.35%, while Ex-Igbariam had the least with 0.27%. Considering the effect of pruning regime on fat content accumulation in each variety, pruning significantly ($p<0.05$) lowered fat contents in Ex-Igbariam with 0.14% for 6 WAP, 0.30% for 8

WAP, and 0.14% for 10 WAP compared to non-pruning with fat content of 0.48%. Same trend is observed in King J where root fat content from non-pruned (0 WAP) (0.50%) was higher than fat contents from the pruned treatments. Contrary trend was observed in Mother's delight where root fat contents from all the pruned treatments were higher than the non-pruned treatment. To have more fat content in the roots at harvest, pruning at 8 WAP for Ex-Igbariam, at 8-10 WAP for King J, amd 6 WAP for Mother's Delight will be a good practice.

Ash content (AC): Ash content is the total amount of minerals present within the fresh roots. The varieties exhibited marginal differences in ash content (AC) across pruning regimes with a range of 0.87 (King J) to 0.90% (Mother's Delight) (Table 6). Pruning regime across varieties also marginally (though significantly) influenced root AC, with a range of 0.86% (pruning at 6 WAP) to 0.90% (pruning at 8 and 10 WAP). The interaction of variety and pruning regime gave the highest root AC of 1.10%by King J pruned at 10 WAP, while King J pruned at 6 WAP had the least root AC of 0.57%. The significant ($p<0.05$) root AC recorded in this study contrasted with the results of Lyimo *et al*. (2010) who reported no significantly differences in the ash contents of the root of the six sweetpotato varieties they studied. The various ranges of root AC observed in this study were close to the 0.50 – 1.52% reported by Omodamiro *et al*. (2013) in 15 sweetpotato cultivars but without pruning. Studying the effect of pruning regime on the AC of each variety, trend analyses showed that in variety Ex-Igbariam, late pruning led to significant reduction in AC from 1.00% in roots of vines pruned at 6 WAP to 0.70% in roots of vines pruned at 10 WAP. Compared to non-pruned treatment, only root AC from pruned vines at 6 WAP was higher than that of non-pruned treatment. Consequently, to maximize minerals in Ex-igbariam roots, its vines should be pruned for targeted end-use at week 6WAP. For Mother's Delight, pruning the vines generally favours higher accumulation of root AC (0.91 – 1.02%) than non-pruning with root AC of 0.68%). Like in Ex-Igbariam, early pruning (at 6 WAP with 1.00% AC and 8 WAP with 1.02% AC) favours higher AC accumulation, while late pruning at 10 WAP causes reduction in root AC (0.91%). For King J, early vine pruning significantly ($p<0.05$) depressed root AC (0.57% at 6 WAP). The highest root AC of 1.10% was at 10 WAP. This is in contrast to the observed trend in Ex-Igbariam and Mother's Delight. It is generally known that the orange-fleshed sweetpotato types had elevated provitamin A compared to the yellow-fleshed type, and so will be expected that Mother's Delight and King J exhibit higher AC than Ex-Igbariam. The higher root AC of Ex-Igbariam above King J means Ex-Igbariam must have higher content of other components of AC. Identifying the various pruning regimes that can significantly increase the ash content (vitamins and minerals) of sweetpotato roots could lead to targeted root production for increased accumulation of such important nutritional factors for improved public health.

Fibre Content: Each of the three varieties had mean root fibre contents across pruning regimes different from one another with Ex-Igbariam having the highest fibre content of 2.54%, while King J with 1.38% had the least. So Ex-Igbariam has the tendency to produce more root fibre than the other two varieties. In the same vein, the four pruning regimes across varieties were significantly different in their root fibre contents, with roots of non-pruned vines having the highest fibre content of 2.43%, and was above all the pruned treatments (1.37% for 6 WAP; 2.10% for 8 WAP; 2.00% for 10 WAP). This suggests that pruning interferes with fibre content production in a significant way. Both varieties and pruning regimes significantly interacted to influence root fibre content. Fibre content ranged between 1.07% (Ex-Igbariam at 10 WAP) and 4.24% (Ex-Igbariam at 0 WAP). Generally, vine pruning led to reduction in root fibre content in Ex-Igbariam. However, if Ex-Igbariam must be pruned, 8 WAP seems to be the best time to prune to ensure the least interference with root fibre accumulation. Unlike in Ex-Igbariam, pruning enhanced fibre content accumulation in King J when compared to the non-pruned treatment (1.10% for 0 WAP; 1.23% for 6 WAP; 1.37% for 8 WAP; 1.81% for 10 WAP). Thus there seems to be gradual increase in fibre content in King J as weeks of pruning were delayed (Table 7). To get maximum fibre in King J roots, the vines should be harvested, and harvesting should be delayed till 10 WAP. Delayed pruning also enhances fibre content accumulation in Mother's Delight. Roots of Mother's Delight vines pruned at 10 WAP had the highest fibre content of 3.13% compared to 1.42% of 6 WAP and 1.83% of 8 WAP. It is interesting to observe that both orange-fleshed varieties accumulate root fibre content later than the yellow-fleshed type. There is need to elucidate further if the biosynthesis of beta-carotene influences fibre biosynthesis. In general, the root fibre contents reported in this study were higher than the reported values of 0.67 – 2.00% by Omodamiro *et al*. (2013).

Using the principal component biplot (Figue 1) to elucidate the various interactions among the proximate compositions, varieties and pruning regimes helps to bring the effects of the three components into clear focus. Root crude fibre was highly impacted by cutting Ex-Igbariam at 0 and 8 WAP. Cutting Mother's Delight at 6 WAP and EX-Igbariam at 0 WAP had good impact on root fat content. The tight closeness of dry matter and carbohydrate contents shows the positive and strong relationship that exists between the two traits. King J cut at 0 and 10 WAP, and Mother's Delight also cut at 10 WAP had positive effects on the accumulation of both traits. Ash content has an acute angle to the duo of dry matter ad carbohydrate contents, making the relationships between them strong. For root ash content, cut vines of King J at 0 and 10 WAP and Mother's Delight at 8 WAP have the tendency to increase ash content. Increase in ash content is an increase in vitamins and minerals in the roots. Just as in ash content, King J cut at 0 and 10 WAP, and Mother's Delight cut at 8 WAP have increasing effects on protein content. The acute angle between protein and ash contents suggests strong relationship, and it will be unexpected if same practices influence their accumulation in the same way. In general, cut vines of King J at 6 and 8 WAP, Mothers Delight at 0 WAP, and Ex-Igbariam at 10 WAP, which were opposite of the planes of positive contribution, had decreasing effects on all the proximate compositions, especially King J at 6 WAp which is the farthest.

Relationship among root proximate composition

Table 9 shows the correlation coefficients (r) for proximate analysis of the 12 root samples from three sweetpotato varieties subjected to four different vine pruning regimes (0, 6, 8 and 10 weeks after planting). From the results, dry matter content is strongly and positively related with carbohydrate (r = 0.997) and ash content (r = 0.921). Though not significant (p>0.05), dry matter content also showed moderate and positive relationship with protein. Carbohydrate and ash contents also showed very strong, positive and significant correlation (r = 0.899***) existing between them. Dry matter and carbohydrate contents had weak correlation with fat and fibre contents with correlation coefficient 'r' ranging between = 0.316 – 0.490. The relationships between ash and fibre contents (r = 0.186), between protein and fat and fibre contents (r = 0.107 and 0.106, respectively), and between fat and fibre contents (r = 0.229) are better described as non-existent. The observed strong and positive relationship between dry matter and carbohydrate contents is expected as the major component of dry matter is carbohydrate (Mias, 2008). The positive correlation that exist between ash, dry mater and carbohydrate means the three important food and nutritional characteristics have the potential of increasing simultaneously as dry matter content is significantly increased in King J and Mother's Delight varieties by pruning. Any treatment that increases the ash content of sweetpotato is inadvertently increasing the vitamins and mineral components, chief of which are vitamins A, C and D, iron, potassium and zinc (Mias, 2008). These are important vitamins and micro-nutrients that have far implications on human health

Conclusion

The various pruning regimes exerted significant effects on the proximate compositions of the roots of the various varieties. The trends of the effects of the pruning regimes on each proximate composition could vary or be the same from variety to variety. Identifying a vine pruning period that could raise the dry matter content of Mother's Delight (a high-yielding, high pro-vitamin A variety with wide adaptability but with low dry matter) from < 25% to > 30% is a major finding that could lead to extensive commercialization of the variety. If the reduction of carbohydrate is an objective, pruning Ex-Igbariam at 10 WAP will reduce the root carbohydrate from above 30% to below 25%. Increasing the protein content of Mother's Delight to compliment the pro-vitamin A is possible by pruning its vines between 8 and 10 WAP. Increasing the ash content of sweetpotato is desirable. Knowing the pruning regimes could significantly increase the minerals and vitamins in the root of the crop is another major finding. To the best of our knowledge, this is the first time these findings are being reported. However, more studies are still needed to study the mechanisms by which these various effects are brought about in each variety, and why the trends differ from one variety to the other.

References

Afuape, S. O., Nwankwo, I. I. M., Omodamiro, R. M., Echendu, T. N. C., & Toure, A. (2014). Studies on some important consumer and processing traits for breeding sweet potato for varied end-uses. *American Journal of Experimental Agriculture, 4*(1):114-124.

Aniekwe, N.L. (2014). Influence of pinching back on the growth and yield parameters of sweet potato varieties in southeastern Nigeria. *Journal of Animal &Plant Sciences*, 20(3): 3194-3201

AOAC. (2002). Official Methods of Analysis. 16th ed. Association of Official Analytical Chemists, Washington, DC.

Burgos, G., Carpio, R., Sanchez, C., Sosa, P., Porras, E., Espinoza, J., & Gruneberg, W. (2009). Guide for using the RHS colour chart for selecting for high β-carotene sweetpotato. *ISTRC, Lima, Peru*.

Cervantes-Flores, J.C,, Sosinski, B., Pecota, K.V., Mwanga, R.O.M., Catignani, G.L., Truong, V.D., Watkins, R.H., Ulmer, M.R. and Yencho, G.C. (2011). Identification of quantitative trait loci for dry matter, starch, and β-carotene content in sweetpotato. *Mol. Breed*. 28 (2):201-216.

CIP (International Potato Center) (2017). Sweetpotato Facts and Figures http://cipotato.org/sweetpotato/facts-2/ [Accessed 04 July, 2017]

FAO (2006). Plant nutrition for food security- A guide for integrated nutrient management. Food and Agriculture Organization (FAO) fertilizer and plant nutrition bulletin 16.

FAO (2017) Corporate Document Repository. Storage and processing of roots and tubers in the tropics by Agriculture and Consumer Protection http://www.fao.org/docrep/X5415E/x5415e01.htm#1.4.3%20sweet%20potato%20(ipomoea%20batatas%20l.) [Accessed 04 July, 2017]

Kapinga, R., Zhang, D., Lemaga, B., Andrade, M., Mwanga, R., Laurie, S., Ndoho, P. and Kanju, E. (2007). Sweetpotato crop improvement in sub-

Saharan Africa and future challenges. Proceedings of the 13th ISTRC Symposium, 2007, pp. 82 – 94.

Kiozya, H.C., Mtunda, K., Kapinga, R., Chirimi, B. and Rwiza, E: (2001). Effect of leaf harvesting frequency on growth and yield of sweet potato in the Lake zone of Tanzania, *African Crop Sc. Journal*, 9 (1): 97-103.

Leon-Verlarde C.U. (2000). Using competing traits to select dual-purpose sweet potato in native germplasm. International Potato Center (CIP) Program Report 1999-2000. pp. 289-294

Lyimo, M.E., Gimbi, D.M. and Kihinga, T. (2010). Effect of processing methods on nutrient contents of six sweet potato varieties in Lake Zone of Tanzania. *Tanzania Journal of Agricultural Sciences*, 10(1)

Mias, A. (2008). Utilization of sweetpotato starch, flour and fibre in bread and biscuits: Physico-chemical and nutritional characteristics. M.Sc. Thesis, Massey University. 178p.

Mohammed, A., Nigussie-Dechassa, R. and Bekele, A. (2012), Effect of planting methods and vine harvesting on shoot and tuberous root yields of sweet potato [Ipomoea batatas (L.)Lam.] in the Afar region of Ethiopia. *African Journal of Agricultural Research* Vol. 7(7), pp. 1129-1141, 19 February, 2012.

Mok, I. G., Zhang, D., & Carey, E. E. (1997, December). Sweet potato breeding strategy of CIP. In *Proceedings of International Workshop on Sweet Potato Production System Towards the 21st Century* (pp. 9-27).

Mwanga, R. O. M., Odongo, B., Niringiye, C., Kapinga, R., Tumwegamire, S., Abidin, P. E., ... & Zhang, D. (2007). Sweetpotato selection releases: lessons learnt from Uganda. *African Crop Science Journal*, *15*(1): 11-23.

Nwinyi, S.C.O. (1992). Effect of age at shoot removal on tuber and shoot yields at harvest of five sweet potato (*Ipomoea batatas* (L) Lam) cultivars, *Field Crop Res*. 29: 47-54

Olorunnisomo, O.A. (2007). Yield and quality of sweet potato forage pruned at different intervals for West African dwarf sheep. *Livestock Research for Rural Development. Volume 19, Article #36.* Retrieved December 3, 2017, from http://www.lrrd.org/lrrd19/3/olor19036.htm

Omodamiro, R. M., Afuape, S. O., Njoku, C. J., Nwankwo, I. I. M., Echendu, T. N. C. and Carey, T. (2013). Acceptability and proximate composition of some sweetpotato genotypes: Implication of breeding for food security and industrial quality. *International Journal of Biotechnology and Food Science, 1*(5): 97-101.

Smart, J. and Simmonds, N.W. (1995). Evolution of Crop Plants. 2nd Edition, John Wiley and Sons, Inc., New York, pp: 57-61. In: Mohammed Ahmed, Nigussie-Dechassa R. and Bekele Abebie (2012). Effect of planting methods and vine harvesting on shoot and tuberous root yields of sweet potato [Ipomoea batatas (L.) Lam.] in the Afar region of Ethiopia. *African Journal of Agricultural Research* Vol. 7(7), pp. 1129-1141, 19 February, 2012

Yamakawa, O. and Yoshimoto, M. (2002). Sweet potato as food material with physiological functions. *Acta Hort. (Internatinal Society for Horticultural Sciences)* 583: 179-185.

Table 1: Mean squares of the analysis of variance of proximate composition of roots from three sweetpotato varieties after vine harvesting at four different regimes

Sources of variation	Degrees of freedom	Dry matter	Carbohydrate	Crude protein	Crude fat	Fibre	Ash
Variety	2	5.673***	59.045***	0.040***	0.02***	4.089***	0.004***
Pruning regime	3	8.640***	6.674***	0.249***	0.061***	1.771***	0.004***
Variety X Pruning regime	6	2.375***	203.611***	0.860***	0.043***	3.643***	0.146***
Residual	24	1.953	0.1256	0.002	0.00005	5.556	5.560
Total	35						

Table 2: Variety, vine pruning regime and their interaction on dry matter content (%) of roots of three sweetpotato varieties pruned at four different pruning periods

Variety	**Pruning regime at:**				**Mean$_{Variety}$**
	0 WAP	**6 WAP**	**8 WAP**	**10 WAP**	
Ex-Igbariam	37.65	33.11	35.11	26.71	33.15
King J.	37.03	21.35	25.38	37.45	30.31
Mother's Delight	22.12	39.99	40.10	36.10	34.58
Mean $_{Pruning\ Regime}$	32.27^b	31.48^a	33.53^d	33.42^c	32.68

FLSD$_{0.05}$: Variety = 0.040; Pruning regime = 0.040; Variety*Pruning regime = 0.075. WAP = weeks after planting

Table 3: Variety, vine pruning regime and their interaction on carbohydrate (%) content of roots of three sweetpotato varieties pruned at four different pruning periods

Variety	**Pruning Regime**				**Mean$_{Variety}$**
	0 WAP	**6 WAP**	**8 WAP**	**10 WAP**	
Ex-Igbariam	34.43	30.17	33.09	24.60	30.57
King J.	33.85	19.66	23.12	33.64	27.57
Mother's Delight	20.03	37.61	36.69	33.26	31.90
Mean $_{Pruning\ Regime}$	29.44^a	29.15^a	30.96^c	30.50^b	30.01

FLSD$_{0.05}$: Variety = 0.345; Pruning regime = 0.299; Variety*Pruning regime = 0.597

Table 4: Variety, vine pruning regime and their interaction on crude protein (%) of roots of three sweetpotato varieties pruned at four different pruning periods

Variety	**Pruning Regime**				**Mean$_{Variety}$**
	0 WAP	**6 WAP**	**8 WAP**	**10 WAP**	
Ex-Igbariam	1.78	1.79	0.83	1.27	1.42
King J.	1.67	0.91	1.09	1.75	1.36
Mother's Delight	1.15	0.95	2.09	1.70	1.47
Mean $_{Pruning\ Regime}$	1.53^c	1.22^a	1.34^b	1.57^c	**1.42**

FLSD$_{0.05}$: Variety = 0.040; Pruning regime = 0.039; Variety*Pruning regime = 0.077

Table 5: Variety, vine pruning regime and their interaction on fat content (%) of roots of three sweetpotato varieties pruned at four different pruning periods

Variety	**Pruning Regime**				**Mean$_{Variety}$**
	0 WAP	**6 WAP**	**8 WAP**	**10 WAP**	
Ex-Igbariam	0.48	0.14	0.30	0.14	0.27
King J.	0.50	0.21	0.38	0.38	0.35
Mother's Delight	0.26	0.42	0.30	0.23	0.30
Mean $_{Pruning\ Regime}$	0.41^d	0.26^b	0.33^c	0.23^a	0.31

FLSD$_{0.05}$: Variety = 0.011; Pruning regime = 0.011; Variety*Pruning regime = 0.012

Table 6: Variety, vine pruning regime and their interaction on ash content (%) of roots of three sweetpotato varieties pruned at four different pruning periods

Variety	**Pruning Regime**				**Mean$_{Variety}$**
	0 WAP	**6 WAP**	**8 WAP**	**10 WAP**	
Ex-Igbariam	0.96	1.00	0.89	0.70	0.89
King J.	1.00	0.57	0.79	1.10	0.87
Mother's Delight	0.68	1.00	1.02	0.91	0.90
Mean $_{Pruning\ Regime}$	0.88^b	0.86^a	0.90^c	0.90^c	0.89

FLSD$_{0.05}$: Variety = 0.007; Pruning regime = 0.006; Variety*Pruning regime = 0.013

Table 7: Variety, vine pruning regime and their interaction on fibre content (%) of roots of three sweetpotato varieties pruned at four different pruning periods

	Pruning Regime				
Variety	**0 WAP**	**6 WAP**	**8 WAP**	**10 WAP**	**Mean$_{Variety}$**
Ex-Igbariam	4.24	1.46	3.40	1.07	2.54
King J.	1.10	1.23	1.37	1.81	1.38
Mother's Delight	1.97	1.42	1.53	3.13	2.01
Mean $_{Pruning\ Regime}$	2.43^d	1.37^a	2.10^c	2.00^b	1.98

FLSD$_{0.05}$: Variety = 0.007; Pruning regime = 0.006; Variety*Pruning regime = 0.013

Table 8: Summary of observed trends of response of root proximate compositions of each variety to pruning regime of sweetpotato vines

Proximate composition	Variety	Observed trend favouring accumulation of proximate composition
Dry matter content	Ex-Igbariam	Early pruning (6-8 WAP)
	King J	Late pruning (10 WAP)
	Mother's Delight	Early pruning (6-8 WAP)
Carbohydrate content	Ex-Igbariam	Early pruning (6-8 WAP)
	King J	Late pruning (10 WAP)
	Mother's Delight	Early pruning (6 WAP)
Crude protein	Ex-Igbariam	Early pruning (6 WAP)
	King J	Late pruning (10 WAP)
	Mother's Delight	Late pruning (8-10 WAP)
Fat content	Ex-Igbariam	No consistent trend (8 WAP)
	King J	Late pruning (8-10 WAP)
	Mother's Delight	Early pruning (6-8 WAP)
Ash content	Ex-Igbariam	Early pruning (6 WAP)
	King J	Late pruning (10 WAP)
	Mother's Delight	Early pruning (6-8 WAP)
Fibre content	Ex-Igbariam	No consistent trend (8 WAP)
	King J	Late pruning (10 WAP)
	Mother's Delight	Late pruning (10 WAP)

Figures in parenthesis represent the vine pruning period after planting that favoured the optimum accumulation of the specific proximate composition of the roots of a particular variety

Table 9: Correlation coefficient analysis of proximate compositions of roots from three sweetpotato varieties after vine harvesting at four different pruning regimes

Variables	% Dry matter	% Carbohydrate	% Ash	% Protein	% Fat
% Carbohydrate	0.997***	-			
% Ash	0.921***	0.899***	-		
% Protein	0.543^{ns}	0.494^{ns}	0.632*	-	
% Fat	0.490^{sn}	0.483^{ns}	0.482^{ns}	0.107^{ns}	-
% Fibre	0.316^{ns}	0.324^{ns}	0.186^{ns}	0.106^{ns}	0.229^{ns}

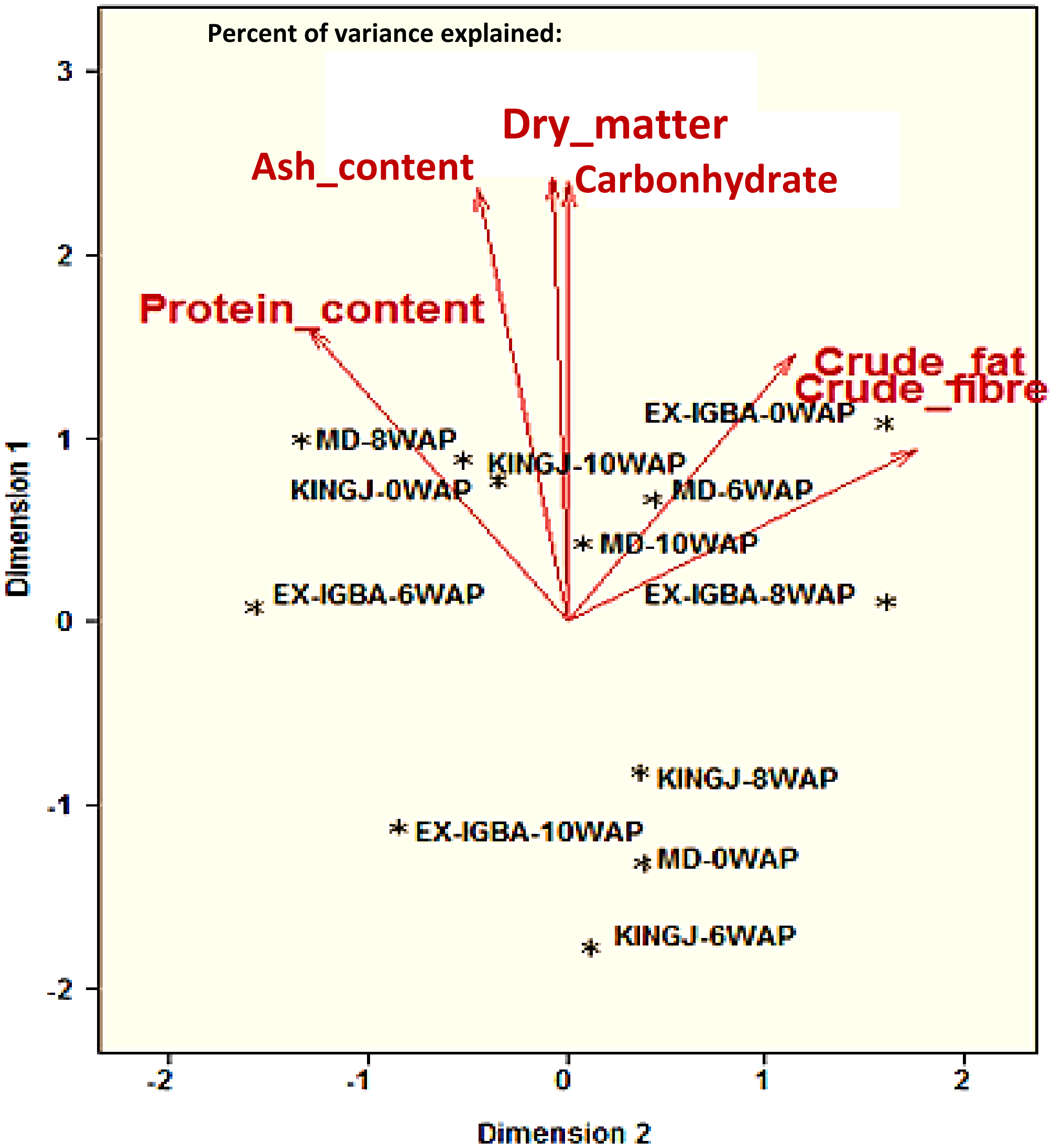

Figure 1: Principal component analysis biplot showing intrinsic interaction relationships among proximate composition, three sweetpotato varieties and four pruning regimes