Yield and Chemical Composition of Cassava Foliage and Tuber Yield as Influenced by Harvesting Height and Cutting Interval

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ABSTRACT : A 3×4 factorial field experiment with a complete randomised split-plot design with four replicates was conducted from June 2002 to March 2003 at the experimental farm of the Nong Lam University, Ho Chi Minh City, Vietnam, to determine effects of different harvesting heights (10, 30 and 50 cm above the ground) and cutting intervals (45, 60, 90 and 285 days) on yield of foliage and tubers, and chemical composition of the foliage. Cassava of the variety KM 94 grown in plots of 5 m×10 m at a planting distance of 30 cm×50 cm was hand-harvested according to respective treatments, starting 105 days after planting. Foliage from the control treatment (285 days) and all tubers were only harvested at the final harvest 285 days after planting. Dry matter and crude protein foliage yields increased in all treatments compared to the control. Mean foliage dry matter (DM) and crude protein (CP) yields were 4.57, 3.53, 2.49, and 0.64 tonnes DM ha^{-1} and 939, 684, 495 and 123 kg CP ha^{-1} with 45, 60, 90 and 285 day cutting intervals, respectively. At harvesting heights of 10, 30 and 50 cm the DM yields were 4.27, 3.67 and 2.65 tonnes ha^{-1} and the CP yields were 810, 745 and 564 kg ha^{-1}, respectively. The leaf DM proportion was high, ranging from 47 to 65%. The proportion of leaf and petiole increased and the stem decreased with increasing harvesting heights and decreasing cutting intervals. Crude protein content in cassava foliage ranged from 17.7 to 22.6% and was affected by harvesting height and cutting interval. The ADF and NDF contents of foliage varied between 22.6 and 30.2%, and 34.2 and 41.2% of DM, respectively. The fresh tuber yield in the control treatment was 34.5 tonnes ha^{-1}. Cutting interval and harvesting height had significant negative effects on tuber yield. The most extreme effect was for the frequent foliage harvesting at 10 cm harvesting height, which reduced the tuber yield by 72%, while the 90 day cutting intervals and 50 cm harvesting height only reduced the yield by 7%. The mean fresh tuber yield decreased by 56, 45 and 27% in total when the foliage was harvested at 45, 60 and 90 day cutting intervals, respectively. It is concluded that the clear effects on quantity and quality of foliage and the effect on tuber yield allow alternative foliage harvesting principles depending on the need of fodder for animals, value of tubers and harvesting cost. An initial foliage harvest 105 days after planting and later harvests with 90 days intervals at 50 cm harvesting height increased the foliage DM and CP yield threefold, but showed only marginal negative effect on tuber yield. ***(Asian-Aust. J. Anim. Sci. 2005. Vol 18, No. 7 : 1029-1035)***

Key Words : Cassava, Foliage, Tuber, Harvesting Height, Cutting Interval

INTRODUCTION

Cassava (*Manihot esculenta* Crantz), a tropical root crop widely cultivated in Vietnam, has great potential as a starch source for both human and animal consumption. The cassava plant also produces a lush crop of leaves, which are high in protein (Meyrelles et al., 1977). The crude protein content in cassava foliage ranges from 19 to 23% of dry matter (Khang and Wiktorsson, 2000; Man and Wiktorsson, 2001; 2002; Arvidsson and Sandberg, 2003). Up to the present time, most of the experimental work reported has been focused on the production potential of cassava root for human and animal food, and only a few published reports have focused on cassava foliage production as a protein feed for livestock, together with tuber production. Hong et al. (2003) tested the effects of different initial stages of cutting and subsequent harvesting interval on yield and nutritive value of cassava foliage. The harvesting height was 10 cm above the ground. They reported that cassava plants harvested initially at 2 months, and then with 2 month intervals between subsequent cuttings produced the same amount of protein, but lower DM foliage yield and fiber components compared with cassava plants harvested at 4 months of initial cutting and 2 months of subsequent cutting. No data on tuber yield was reported. It was concluded that initial cutting at 2 months, with subsequent cutting at 2 month intervals was optimal for high DM and protein yields of cassava foliage. However, the effects of different harvesting heights and intervals on foliage and tuber yields and nutritive value of cassava foliage have not yet been fully investigated. The objectives of this experiment were to determine whether a high tuber yielding variety, KM 94, could yield reasonable amounts of foliage as well as tubers under these conditions.

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Received September 26, 2004; Accepted February 16, 2005

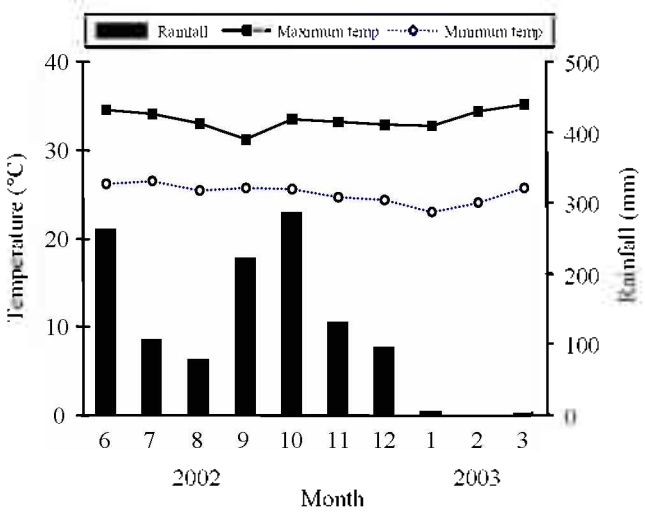

Figure 1. Monthly rainfall and temperature at the time of the experiment.

MATERIALS AND METHODS

The foliage and tuber production study was conducted from June 2002 to March 2003 at the experimental farm of Nong Lam University, Ho Chi Minh City, Vietnam. The soil contained 54% sand, 39% silt, 7% clay, 0.62% organic carbon, with 6.87, 76.21, 3.69, 1.13 and 0.13 meq per 100 g of N, P, K, Ca and Mg, respectively, and a pH_{KCl} of 5.79 at 15 cm depth (Soil Chemistry Lab. Data, Nong Lam University, Ho Chi Minh City, Vietnam, 2002).

The weather conditions at the experimental site are characterized by a tropical monsoon climate with two main seasons, rainy and dry. During the experiment, the rainy season lasted from May to December, with peaks in June and November and an annual precipitation of about 1,900 mm. The dry season started in February and lasted through April. The monthly mean temperatures ranged from about 27.5°C to 34°C with minima in December and February and maxima during the dry season. The mean relative humidity was 76% (Figure 1).

The land was first cleared from weeds, and then ploughed by tractor to a depth of 20-25 cm to loosen the soil. Weeds were also removed twice during the establishment period. All treatments received a total of 80 kg ha^{-1} nitrogen (N), 40 kg ha^{-1} phosphorus (P_2O_5) and 120 kg ha^{-1} potassium (K_2O), of which half was applied at planting. The rest was split into two to four dressings applied after each successive foliage harvest. In the treatment with the foliage harvested only at 285 days post planting the dressings were applied after 150, 195 and 240 days, respectively.

A 3×4 factorial field experiment with a completely randomized split-plot design with four replicates was conducted. Each one of the four blocks was divided into 3 main plots with harvesting heights 10, 30 and 50 cm above the ground. Cutting intervals of 45, 60, 90 and 285 days were randomly split over the main plot (Mead et al., 1993). The experiment was set up in a field of 3,000 m^2, of which 2,400 m^2 was used for planting and 600 m^2 was border areas. The individual plot size was 5 m×10 m. An area of 200 m^2 was used for the main plot, 50 m^2 for each sub-plot and a 1 m wide alley between the plots and the blocks to facilitate movement from plot to plot.

Cassava, variety KM 94, was planted early June 2002 and the final harvest was 285 days after planting. Planting materials were chosen from healthy and disease-free plants and cut into segments just before planting. Cassava stem was planted in continuous rows with 50 cm between rows, 30 cm between stem cuttings, and grown as a pure stand. The length of stem was 20-25 cm. The planting depth was 15 cm. Cassava plants were established 105 days before the first cutting at 10, 30 and 50 cm above the ground. From then onwards the plots were harvested according to the plan at 45, 60 and 90 days until 285 days after planting. The control treatment was only harvested at 285 days, and only the upper part including green leaves, petioles and stems cut just below the lowest green leaf. This was approximately 30 cm from the top.

Cassava foliage (comprising young stems, leaves and petioles) was hand-harvested and cut according to respective treatments. Cassava foliage was harvested between 08:00 h to 10:00 h to avoid HCN fluctuation, which occurs later during the day due to the hot sun (Yeoh and Oh, 1979). Cassava tubers from all treatments were harvested at the final harvest. All cassava foliage and tubers from each plot were weighed to determine the fresh yield. The fresh foliage was sampled and pooled from the 3 replicates (1.5 kg fresh weight each), and was placed in a porous paper bag for dry matter determination and chemical analyses. A similar sample was collected to determine the ratio of leaf, petiole and stem to total foliage on a DM basis. The contents of crude protein (CP), ether extract (EE) and total ash in the samples were determined according to the procedure of AOAC (1990). The contents of neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined according to the procedure of Van Soest et al. (1991). Total condensed tannin was determined by the butanol-HCl method (Terrill et al., 1992).

Data were statistically analyzed by using General Linear Model Procedure of Minitab Statistical Software version 13.31. When the *F*-test was significant ($p<0.05$), the Tukey's Tests for paired comparisons was used to compare means. The relationship between foliage yields or tuber yield, respectively, and cutting intervals were determined using the linear or quadratic responses in Fitted Line Plot procedure of Minitab 13.31.

Table 1. Foliage and tuber yields of cassava with different harvesting heights and cutting intervals

Yield (tonnes ha^{-1})	HH* (cm)	CI** (days) 45	60	90	285[3]	Mean[1]	HH SEM	CI SEM	p-value HH	CI	HH×CI	R^2
Fresh foliage												
	10	25.14	22.49	18.19	2.30	17.03^a						0.96
	30	24.71	20.42	14.75	2.18	15.52^b						0.91
	50	18.13	15.23	11.77	2.12	11.81^c						0.91
	Mean[1]	22.66^a	19.38^b	14.90^c	2.20^d		0.42	0.49	0.001	0.001	0.002	
DM[2] foliage												
	10	5.31	4.38	3.11	0.68	3.37^a						0.88
	30	4.98	3.63	2.41	0.64	2.92^b						0.78
	50	3.40	2.58	1.96	0.62	2.14^c						0.82
	Mean[1]	4.57^a	3.53^b	2.49^c	0.64^d		0.08	0.10	0.001	0.001	0.001	
Tuber												
	10	9.66	13.73	18.58	34.41	19.10^a						0.91
	30	16.69	17.99	25.31	34.51	23.63^b						0.81
	50	19.39	25.29	31.92	34.48	27.77^c						0.51
	Mean[1]	15.25^a	19.01^b	25.27^c	34.47^d		0.71	0.82	0.001	0.001	0.003	

[1] For each set of means, all those with different superscript letter(s) are significantly different from each other at $LSD_{0.05}$.
[2] Estimated yield.
[3] All harvest heights were the same: approximately 30 cm from the top just below the lowest green leaf.
* HH: Harvesting height. ** CI: Cutting interval.

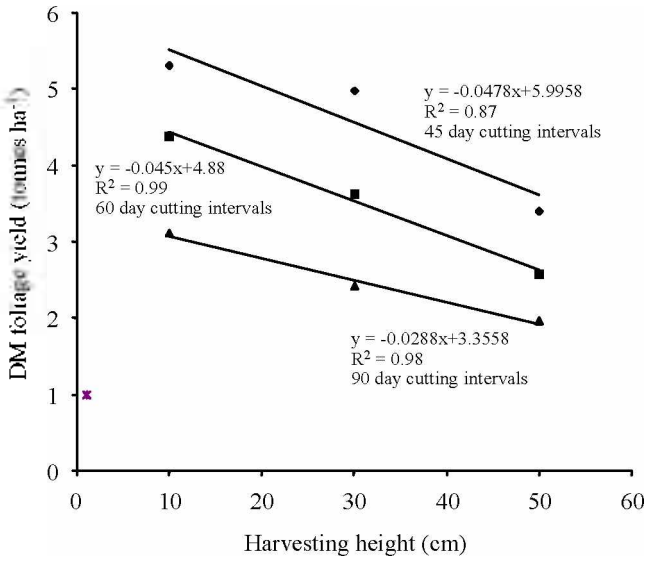

Figure 2. DM foliage yield of cassava in relation to harvesting height at 45, 60 and 90 day cutting intervals.

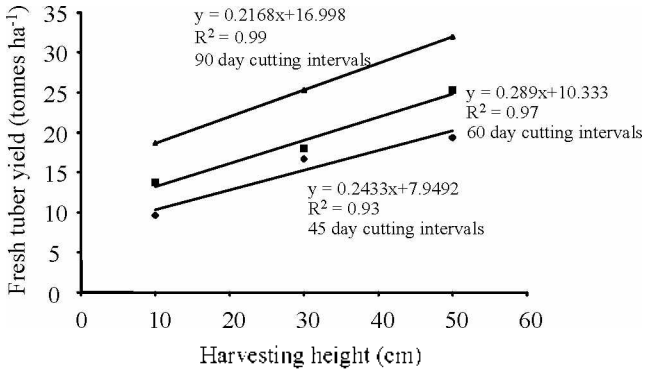

Figure 3. Fresh tuber yield of cassava in relation to harvesting height at 45, 60 and 90 day cutting intervals.

RESULTS

Effects of harvesting height and cutting interval on yield of foliage and tubers

Data on foliage and tuber yields of cassava for the whole period of 285 days after planting are summarized in Table 1. Both the harvesting height and cutting interval had significant effects on yield. The control treatment with the only foliage harvest at 285 days had a significantly lower foliage yield than all the other treatments. Compared with the control treatment, the mean DM foliage yield was 6, 5 and 3 times higher when the foliage was harvested at 45, 60 and 90 day cutting intervals, respectively. Ten cm harvesting height and 45 day cutting intervals resulted in the highest foliage yield ($p<0.001$). The SEM and p-value for harvesting height and cutting interval and the R^2-values associated with the linear effects are also shown in Table 1. The linear decrease in dried cassava foliage yields with increasing harvesting heights for each one of the three cutting intervals is illustrated in Figure 2. Compared with the mean harvesting height at 10 cm above the ground for all cutting intervals, there was an average decrease of 14 and 38% in total DM foliage yield when the foliage was harvested at 30 and 50 cm heights, respectively.

Cutting interval and harvesting height had significantly negative effects on tuber yield (Table 1). The most extreme effect was for the frequent foliage harvesting at 10 cm harvesting height, which reduced the tuber yield by 72%, while the 90 day cutting intervals and 50 cm harvesting height only reduced the yield by 7%. The mean fresh tuber

yield decreased by 56, 45 and 27% in total when the foliage was harvested at 45, 60 and 90 day cutting intervals, respectively. The linear increase ($p<0.001$) in fresh cassava tuber yield with increasing harvesting height at the three cutting intervals is illustrated in Figure 3.

Effects of harvesting height and cutting interval on fresh and dried weight proportions of foliage

Fresh and dried weight proportions of cassava foliage at different harvesting heights and cutting intervals are presented in Table 2. There were significant differences in the proportion of leaf, petiole and stem between treatments. Percents of leaf and petiole increased with increasing harvesting heights and frequencies of cutting, while proportion of stem showed the opposite trend. The results were the same for both fresh and dried weight proportions of cassava foliage.

Effects of harvesting height and cutting interval on chemical composition of foliage

The analyses showed that CP content in cassava foliage varied from 17.7 to 22.6% of DM (Table 3). Both harvesting height and cutting interval influenced CP content. The highest value was found at 50 cm harvesting height and the lowest at 10 cm harvesting height. The 45 day cutting intervals resulted in the highest value, while the samples after 285 days of growth had the lowest protein content. Mean foliage CP yields were 939, 684, 495 and 123 kg ha^{-1} at 45, 60, 90 and 285 days cutting intervals, respectively, and 810, 745 and 564 kg CP ha^{-1} at 10, 30 and 50 cm harvesting heights, respectively. The highest CP production was obtained at 30 cm harvesting height and 45 days cutting interval (1,110 kg CP ha^{-1}), while the CP yield was only 123 kg ha^{-1} from the foliage harvested once at 285 days after planting. The total CP yield was three times higher (369 kg ha^{-1}) when harvested with 90 days interval and 50 cm harvesting height.

The ADF and NDF contents of foliage varied between 22.6 and 30.2%, and 34.2 and 41.2% of DM, respectively, and were affected by both harvesting height and cutting interval. The mean HCN content of fresh foliage decreased with increasing cutting interval but increased with harvesting height (Table 3). There were no differences in the content of ether extract, ash and tannin between treatments, except for tannin, which increased at longer cutting intervals. The interaction between the treatment factors harvesting height and cutting interval was highly significant for all the determined components.

Table 2. Fresh and dried weight proportions of cassava foliage with different harvesting heights and cutting intervals

Proportion	HH*	CI** (days)				Mean[1]	HH	CI	p-value		
(%)	(cm)	45	60	90	285[2]		SEM	SEM	HH	CI	HH×CI
Fresh proportion											
Leaf	10	58.20	57.87	56.48	58.48	57.76^{a}					
	30	62.34	61.71	61.10	59.76	61.23^{b}					
	50	62.01	62.98	60.62	61.04	61.66^{c}					
	Mean[1]	60.85^{a}	60.85^{a}	59.40^{b}	59.76^{b}		0.09	0.10	0.001	0.001	0.001
Petiole	10	22.47	19.51	15.90	22.35	20.06^{ab}					
	30	21.10	19.81	16.98	21.71	19.90^{a}					
	50	21.86	19.84	18.22	20.94	20.21^{b}					
	Mean[1]	21.81^{a}	19.72^{b}	17.03^{c}	21.67^{a}		0.07	0.08	0.01	0.001	0.001
Stem	10	19.33	22.63	27.62	19.17	22.19^{a}					
	30	16.56	18.48	21.92	18.54	18.87^{b}					
	50	16.13	17.18	21.17	18.02	18.13^{c}					
	Mean[1]	17.34^{a}	19.43^{b}	23.57^{c}	18.58^{d}		0.05	0.06	0.001	0.001	0.001
Dried proportion											
Leaf	10	63.00	58.24	46.97	65.28	58.37^{a}					
	30	64.06	57.90	51.66	65.35	59.74^{b}					
	50	65.38	57.69	52.88	65.35	60.33^{c}					
	Mean[1]	64.15^{a}	57.94^{b}	50.50^{c}	65.33^{d}		0.08	0.09	0.001	0.001	0.001
Petiole	10	19.03	19.77	17.78	17.98	18.64^{a}					
	30	19.32	21.00	20.16	17.87	19.59^{b}					
	50	19.87	22.90	21.06	18.01	20.46^{c}					
	Mean[1]	19.41^{a}	21.22^{b}	19.67^{c}	17.95^{d}		0.03	0.04	0.001	0.001	0.001
Stem	10	17.97	21.99	35.24	16.74	22.99^{a}					
	30	16.62	21.10	28.17	16.78	20.67^{b}					
	50	14.75	19.72	26.06	16.63	19.21^{c}					
	Mean[1]	16.45^{a}	20.84^{b}	29.82^{c}	16.72^{d}		0.06	0.07	0.001	0.001	0.001

[1] For each set of means, all those with different superscript letter(s) are significantly different from each other at $LSD_{0.05}$.

[2] All harvest heights were the same: approximately 30 cm from the top just below the lowest green leaf.

* HH: Harvesting height. ** CI: Cutting interval.

DISCUSSION

In the present study, the time after planting at which the foliage harvest started was 105 days for all treatments except the control treatment of 285 days, which was only harvested at the end of the total growing period. The first foliage harvest day of 105 was based on conclusions from previous reports (Lockard et al., 1985; Tung et al., 2001) in which it was concluded that the time to first harvest for high leaf yield should not be shorter than 3 months after planting. Jalloh (1998) showed that delaying the first foliage collection until the fourth month allows the plant to pass the most critical stage for its tuberous root yield. According to Lockard et al. (1985), the time at which collection started had very little effect on the weight of leaves harvested. In the present study, yield of cassava foliage was highest at 10 cm harvesting height and 45 day cutting intervals. These results were consistent with the work of Dahniya et al. (1981) and Hong et al. (2003) who recommended foliage harvest at interval of 2 months and 10 cm height above the ground. However, they were not consistent with the recommendations of others that harvesting should be done every month when only foliage is considered (Lutaladio and Ezumah, 1981). The mean DM yields of foliage collected at 60, 90 and 285 day cutting intervals were only 77, 55 and 14%, respectively, of the weight of foliage collected at 45 day cutting intervals. Dry matter yield of cassava foliage in the present study decreased from 4.6 to 2.5 tonnes ha^{-1} when cutting interval increased from 45 days to 90 days and from 4.3 to 2.7 tonnes ha^{-1} at 10 cm versus 50 cm harvesting height, when excluding the control treatment of 285 days. The foliage yield from the harvest at 285 days

Table 3. Average chemical composition (% DM) of cassava foliage with different harvesting heights and cutting intervals

Nutrition	HH* (cm)	CI** (days) 45	60	90	285[2]	Mean[1]	HH SEM	CI SEM	p-value HH	CI	HH×CI
Dry matter (%)											
	10	21.13	19.49	17.11	29.51	21.81[a]					
	30	20.17	17.19	16.35	29.19	20.88[b]					
	50	18.74	16.94	16.66	29.14	20.37[c]					
	Mean[1]	20.01[a]	18.07[b]	16.71[c]	29.28[d]		0.12	0.13	0.001	0.001	0.001
Percentage of DM (%)											
CP	10	17.69	19.05	21.10	19.39	19.06[a]					
	30	22.30	18.38	19.04	19.38	19.77[b]					
	50	22.62	21.42	18.85	18.33	20.31[c]					
	Mean[1]	20.87[a]	19.62[b]	19.33[b]	19.03[b]		0.14	0.17	0.001	0.001	0.001
EE	10	6.96	7.31	7.86	7.83	7.49					
	30	7.85	7.38	7.38	7.67	7.57					
	50	7.82	7.89	7.27	7.39	7.59					
	Mean[1]	7.55	7.53	7.51	7.63		0.03	0.04	0.117	0.154	0.001
Ash	10	4.98	5.24	5.36	5.26	5.20					
	30	5.29	5.08	5.22	5.25	5.21					
	50	5.29	5.25	5.07	5.24	5.21					
	Mean[1]	5.19	5.19	5.21	5.25		0.02	0.02	0.922	0.075	0.001
NDF	10	39.63	38.97	39.25	34.19	38.01[a]					
	30	35.99	39.87	40.34	35.29	37.87[a]					
	50	35.71	35.76	41.22	36.11	37.20[b]					
	Mean[1]	37.11[a]	38.20[b]	40.27[c]	35.18[d]		0.17	0.19	0.005	0.001	0.001
ADF	10	30.23	29.84	29.46	22.57	28.02[a]					
	30	27.36	29.34	29.29	23.66	27.41[b]					
	50	26.89	26.66	28.20	24.45	26.55[c]					
	Mean[1]	28.16[a]	28.61[b]	28.99[b]	23.56[c]		0.09	0.11	0.001	0.001	0.001
Tannin	10	3.14	3.64	3.97	4.26	3.75[a]					
	30	3.77	3.44	3.70	4.32	3.81[a]					
	50	3.72	3.79	3.61	4.21	3.83[a]					
	Mean[1]	3.54[a]	3.62[a]	3.76[b]	4.26[c]		0.02	0.03	0.067	0.001	0.001
HCN (mg 100 g^{-1} fresh weight)											
	10	85.37	89.85	89.51	84.47	87.30[a]					
	30	92.06	89.89	87.05	83.95	88.24[a]					
	50	95.80	90.09	87.97	83.47	89.34[b]					
	Mean[1]	91.08[a]	89.94[a]	88.18[b]	83.97[c]		0.29	0.33	0.001	0.001	0.001

[1] For each set of means, all those with different superscript letter(s) are significantly different from each other at $LSD_{0.05}$.

[2] All harvest heights were the same: approximately 30 cm from the top just below the lowest green leaf.

* HH: Harvesting height. ** CI: Cutting interval.

was much lower (0.64 tonnes ha^{-1}). The foliage yields were slightly lower than the figures reported by Tung et al. (2001). They conducted an experiment in which three cassava varieties (MM 92, Black Twig and Local) were grown for foliage yield estimation. The results showed that dry foliage yields of MM 92, Black Twig and Local cut at 45 day cutting intervals and about 15 cm harvesting height over the 5 harvests were 5.9, 5.7 and 4.3 tonnes ha^{-1}, respectively. Hong et al. (2003), investigating the foliage yield of cassava, variety KM 60, cut at 1 and 2 month intervals, reported yields of 6.5 to 7.9 tonnes ha^{-1}, respectively. Thus, differences in DM foliage yield could be due to the differences in variety (Gomez and Valdivieso, 1984; Simwambana et al., 1992), fertilizer (Molina and El-Sharkawy, 1995), age at first cutting and interval between cuttings (Lockard et al., 1985; Simwambana et al., 1992; Tung et al., 2001; Hong et al., 2003). Although there is no data shown from the present study on the effects of seasons on cassava foliage yield, DM yield was reduced in all the treatments during the last three months of the experimental period, most likely due to the onset of dry season.

The mean dry leaf proportion of the foliage was high (59%) but with a wide range, from 47 to 65% (Table 2). The mean was slightly higher than found in an earlier study by Meyrelles at al. (1977) where the leaf proportion of cassava foliage on DM basis was almost 52%. Total dry leaf and petiole yields were 82% of shoot yield (leaf and petiole: stem ratios of 4.6) in our study, which were lower than the values obtained by Tung et al. (2001). They reported average leaf and petiole: stem ratios of 5.0, 5.9 and 4.8 for MM 92, Black Twig and Local varieties, respectively. The yield difference between varieties is obvious, in addition to environmental and treatment factors. In the present study, the dry leaf proportions were lower with increasing cutting intervals.

Crude protein content of cassava foliage ranged from 17.7 to 22.6% on DM basis in all treatments (Table 3). These results were similar to the figure of 22.8% reported by Khang and Wiktorsson (2000), and 18.8% reported by Man and Wiktorsson (2001). The results showed that CP content on DM basis fell from 20.9 to 19.0% as cutting intervals increased from 45 to 285 days, while CP content of foliage increased from 19.1 to 20.3% with increasing harvesting height from the ground. Meyrelles et al. (1977) reported a wider range of CP content in foliage, from 18 to 13%, as age at first cutting increased from 3 to 5 months at an average harvesting height of 40 cm above the ground. Estimated protein yield in the present study ranged from 0.37 to 1.11 tonnes ha^{-1} with increasing cutting frequency from three to five cuts at 90 day and 45 day intervals, respectively, during the growing period of 285 days. This was lower than the levels of 1.2 to 1.6 tonnes ha^{-1} with three to six cuts reported by Hong et al. (2003), and from 1 to 1.5 tonnes ha^{-1} with five cuts at 45 day interval for three cassava varieties reported by Tung et al. (2001).

Fibre components of cassava foliage varied from 34.2 to 41.2% of NDF and from 22.6 to 29.8% of ADF. Longer cutting intervals increased NDF and ADF contents, while a decrease was seen with increasing height at cutting. The levels of NDF and ADF were equal to those found by Arvidsson and Sandberg (2003), but lower than those reported by Hong et al. (2003), and Man and Wiktorsson (2001, 2002). The differences were probably due to differences in cassava variety, study site and seasonal conditions.

Cyanide level varied from 83.5 to 95.8 mg 100 g^{-1} fresh weight (Table 3). Compared with the cutting interval of 45 days, there was a decrease of 1.3 and 3.2% in HCN levels when the foliage was harvested at 60 and 90 day intervals, respectively.

Root yield was strongly affected by cutting interval and harvesting height, with a reduction in tuber yield of 72% as the most extreme result at 10 cm harvesting height and 45 day cutting intervals, compared to the control treatment without any foliage harvest until 285 days after planting. On the contrary 90 day cutting intervals and 50 cm harvesting height reduced the tuber yield only by 7%. A similar, but less pronounced affect has been reported by Dahniya et al. (1981) with a high yielding cassava tuber variety. However, they only picked the leaves from the top 30 cm of each branch at 1, 2, and 3 month intervals.

The clear effects on quantity and quality of foliage and the effect on tuber yield allow alternative foliage harvesting strategies depending on the need of fodder for animals, value of tubers and harvesting cost.

CONCLUSIONS

Harvesting height and cutting interval strongly influenced the DM and CP yield of cassava foliage and the fresh weight of root tubers, and to a less extent the nutritional quality of foliage produced during a growing season of 285 days. The highest DM foliage yield was eight times higher with the combination of lowest harvesting height and shortest cutting interval, as compared to only one cut of the green foliage tops at the end of the season. The opposite was seen for tuber production from the same treatments, with only 28% of the tuber yield at the highest foliage production. The CP production was nine times higher at 30 cm harvesting height and 45 days cutting interval. It is therefore concluded that different foliage harvesting strategies can be developed depending on the need of fodder, economic value of the tubers and harvesting costs.

ACKNOWLEDGMENTS

The authors are grateful to the Swedish International Development Cooperation Agency, Department for Research Cooperation (Sida/SAREC) for funding this study and Mr. Tuan, Mr. Tam and Mr. Thanh for their technical help.

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