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Debranching effect on growth and yield in Cassava

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Abstract: Effect of branch pruning on morphological characters and fresh root (tuber) yield in Cassava (*Manihot esculenta)* was investigated at Mymensingh (24°75'N, 90°50'E) between February and October, 2009. Two factors (shoot number and branch clipping) experiment was conducted in a randomized complete block design. The effect of shoot number (one or two shoots per plant) and debranching (control, 1-branch, 2-branches, 3-branches removal) on canopy characters and tuber yield was investigated. Generally, shoot number significantly influenced stem and leaf growth with little effect on tuber yield. Morphological characters leaf and stem growth, and tuber yield decreased with increasing debranching. Maximum tuber yield was observed in control plant (average of 3.74 kg per plant), both in one and two shooted plants. Increased tuber number with wider tuber size appeared to be the index of higher yield. It may be concluded that yield and yield components of Cassava decreased in debranched plants.
Key words: *Manihot esculenta,* debranch, laterals branch, reproductive branch, canopy, tuber

Introduction

Cassava (*Manihot esculenta* Crantz) is a shrub that produces storage root (tuber) in 8-12 month. Starchy tubers are used as staple food and raw materials in food, feed, paper, garment and pharmaceutical industries. Cassava leaves are rich sources of protein, vitamins B_1, B_2, and C, minerals and carotenoids. Whole plant of cassava contains cyanogens which produces hydrogen cyanide gas during processing. After careful processing, leaf could be used as vegetable and animal feed. Morphological characters very with cultivar, location and method of cultivation. The plant height ranges from about 1 to 3 m or more. The stems are usually slender and glabrous, with leaves borne near the apex; the lower parts of the stems have nodes made conspicuous by prominent leaf scars. Cassava branching is variable; some cultivars branch near the base and are spreading in form, others are erect and branch nearer the apex. Mainstem forks in to 2 to 3 primary branches, which further produce laterals and laterals in turn give rise to reproductive branches. The simple leaves are spirally arranged have petioles 5-30 cm long, usually longer than the blades; the blades are deeply palmately divided with 5-7 (occasionally 3-9) lobes, each 4-20 cm long and 1-6 cm wide.

Cassava is a good agroforestry species because farmers can cultivate agricultural crops and pasture with it different agricultural crops such as cowpea, watermelon, muskmelon, potato, turnip, cabbage can be cultivated with cassava in high land. 'Jhum' cultivation is a special cultivation technique of agroforestry. The cultivation of cassava, for family consumption, has been started 1948 by the tribal people of the locality with 'Jhum' cultivation. It is not widely cultivated in Bangladesh. Now it is grown in some areas of Comilla, Madhupur and Chittagong Hill tract regions. Most farmers are interested in growing cassava on commercial basis if the facilities for marketing storage and procession are available in the localities.

Cassava is planted primarily for tuber production but is cutback, pruned or defoliated for various reasons in different parts of Africa. Its pruning's are usually fed to small ruminants in the southern part of Nigeria. Castellanos (1981) noted that pruning of cassava to reduce light interception and excess leaf area produced by some cultivars benefited legumes planted in the late season. While Okoli and Wilson (1982) found that simulated cutback of cassava at different heights was similar to the damage done to cassava plants by maize harvesting machine and did not adversely affect the performance of cassava, thus, allaying the fear of negative effects of pruning or cutback on cassava yield.

Some important morphological characteristics of cassava have already been documented in different parts of the world (Granda *et al.,* 2000; Ramanujam, 1985; Veltkamp, 1985). Growth and yield characteristics have also been reported by different workers (Segnou, 2002; Rani and Ramaswamy, 2001; Lima *et al.,* 2000). Although some information on morphology, branch number effect on yield and growth study in Bangladesh is available (Islam *et al*, 2007a,b; Islam *et al*, 2008) there is no published research on the effect of debranching on canopy structure, growth and yield in cassava. The current study investigated such effects under Mymensingh condition.

Materials and Methods

The experiment was conducted at the Field Laboratory, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh (24°75'N, 90°50'E) during the period from February, 2009 to October, 2009. As planting material, stalks (stems) were collected from tribal farmers of Modhupur tribal region. The experimental field was first opened on February 5, 2009 with a power tiller. The land was ploughed and cross-ploughed three times followed by laddering to obtain the desirable tilth. All the stubbles and uprooted weeds were removed to make the land ready for sowing. The whole land was divided into plots maintaining the desired spacing. The size of each unit plot was 3.6 m x 3.6 m and the plots were spaded one day before planting and the basal dose of fertilizers was incorporated thoroughly before planting. The entire amount of urea, triple super phosphate and muriate of potash at the rate of 83, 62 and 62 kg/ha, respectively, was applied at the time of final land preparation. Well-decomposed cowdung was also applied (1656 kg/ha) during initial land preparation.

Experimental design and layout: The Cassava accession CK A_2 was considered. Two factor (shoot number and de-branching) experiment was conducted using randomized complete block design (RCBD) with three replications. Either one (1-shooted plant, S_1) or two (2-shooted plant, S_2) shoots were allowed from each stem cutting. At 125 days after planting, primary branches were clipped off: control (no debranching, D_0), 1-branch (D_1), 2-branches

(D_2) and 3-branches (D_3) were removed. The eight treatments (S_1D_0, S_1D_1, S_1D_2, S_1D_3, S_2D_0, S_2D_1, S_2D_2, and S_2D_3) were randomly allotted following RCBD design. The distance between blocks and plots was 0.9 m and 0.6 m, respectively. The plots were raised up to 15 cm from the soil surface. Healthy and uniform sized (about 18-20 cm with 8-10 nodes) cutting stalks (stems) of 12 months old plants were planted in the experimental plots by making hole for each stalk on 26 February, 2009. The two stalks were planted at each hole horizontally 2.5 cm below the soil. There were 16 plants/plot(12.96 m^2). The cuttings were watered after planting and continued for several days until their establishment. The dead cutting stalks were replaced with new stalks. The gaps were filled up within four weeks after sprouting of stalks. The soil had adequate moisture so irrigation was not required but weeding was done as when required.

Crop sampling and data collection: The destructive harvest was made between 1 and 3 October 2009. It was done 245 days after planting (DAP). At the time harvesting, four plants were selected randomly from each plot in a replication and data on morphological characters of canopy characters, fibrous and storage roots were recorded. Leaf area index (LAI) was estimated by Canopy Analyser (Model no. LI-3000, USA) and chlorophyll content was measured by Spadometar (Model-667, USA).The collected data were analyzed and mean differences were evaluated by Duncan's New Multiple Range Test (DMRT) (Gomez and Gomez, 1984). A correlation study between storage root yield and other important yield parameters was also carried out.

Results

Morphological characters: Shoot number had little effect on morphological characters (Table 1). Stem diameter and leaf area index (LAI) were greater in 1-shooted plant (S_1) (2.94 cm and 2.89 for diameter and LAI, respectively) than that of 2-shooted (S_2) one (2.00 cm and 2.35 for diameter and LAI, respectively).

Table1. Effect of shoot number, debranching and their interaction on morphological characters at 245 days after planting (DAP) in Cassava

Treatment	Bud per cutting	Plant height (cm) at 240 DAP	Stem base diameter (cm)	Number of branch per plant			SPAD at 210 DAP	LAI
				Primary	Lateral	Reproductive branch		
Shoot no. (S)								
1-shoot (S_1)	3.875	358.028	2.947a	1.354	4.50	9.833	32.524	2.892a
2-shoot (S_2)	3.813	365.818	2.006b	1.375	4.45	9.708	31.119	2.358b
Level of sign.	NS	NS	**	NS	NS	NS	NS	*
LSD $_{0.05}$	-	-	0.083	-	-	-	-	0.55
Debranching (D)								
Control (D0)	4.000	397.80a	2.833b	2.667a	6.292a	13.08a	32.35	2.840
1-branch (D_1)	3.833	382.60a	2.977a	1.792b	4.542b	10.04b	32.96	2.437
2-branch (D_2)	3.792	390.00a	2.956a	1.000c	2.500c	6.667c	30.00	2.338
3-branch (D_3)	3.750	377.30b	2.740b	-	4.583b	9.292b	31.98	2.883
Level of sign.	NS	**	**	**	**	**	NS	NS
LSD $_{0.05}$	-	25.870	0.118	0.162	0.821	1.004	-	-
Interaction (S×D)								
S_1D_0	4.08	382.54a	2.87	2.67 a	6.08 ab	13.00 a	32.20	3.03
S_1D_1	3.83	377.91a	3.09	1.75 b	4.25c	9.67 b	33.18	2.79
S_1D_2	3.83	393.42a	3.02	1.00 c	2.58d	7.11 c	33.04	2.52
S_1D_3	3.75	278.23 b	2.81	-	5.08 bc	9.50 b	31.66	3.21
S_2D_0	3.91	412.97 a	2.80	2.67 a	6.50 a	13.17 a	32.49	2.65
S_2D_1	3.83	387.25 a	2.86	1.83 b	4.83c	10.42 b	33.72	2.08
S_2D_2	3.75	386.64 a	2.90	1.00 c	2.42 d	6.17 c	26.96	2.15
S_2D_3	3.75	276.14 b	2.67	-	4.08 c	9.08 b	32.31	2.55
Level of sign.	NS	**	NS	**	**	**	NS	NS
LSD $_{0.05}$	-	36.590	-	0.228	1.160	1.421	-	-

*, **: indicates significance at P≤0.01 and P≤0.05, respectively, NS = not significant. In a column within a particular treatment, figures followed; by different letters are significant at P≤0.05.

Debranching significantly influenced canopy structure (Table 1). Plants were shorter and thinner after removal of three branches (D_3) (377.30 cm and 2.74 cm for plant height and diameter, respectively than other debranching treatments. Control plant had greater number of primary, lateral and reproductive branches than the 1-branch removal (D_1) and 2-branch removal (D_2). Interaction effects of shoot number and debranching on morphological characters were also significant (Table 1). Plant height was decreased at D_3 in both S_1 and S_2. Numbers of primary branches were decreased with increasing order of debranching. Numbers of lateral branches were also decreased with increasing debranching up to D_2 followed by an increase at D_3. Similar trend was observed in case of reproductive branches.

Leaf and stem growth: Shoot number had significantly affected leaf and stem growth (Table 2). Leaf number, leaf fresh and dry weights, leaf-lobe fresh and dry weights, petiole fresh and dry weights, and stem plus branch fresh and dry weights, leaf-lobe area were greater at 2-shooted (S_2) plant (676.46, 3899.88 g, 711.85g, 1714.46g, 490.50g, 1615.49g, 281.31g, 3277.19g, 1023.48g and 20.32 m^2 for

leaf number, leaf fresh and dry weights, leaf-lobe fresh and dry weights, petiole fresh and dry weight, leaf-lobe area, respectively) than that of 1-shooted (S_1) one (410.98, 2066.43g, 408.95g, 1212.05g, 257.47g, 856.09g, 146.49g, 1671.91g, 522.78g and 10.77 m^2 for leaf number, leaf fresh weight dry weights, leaf-lobe fresh and dry weights, petiole fresh and dry weights, leaf-lobe area, respectively).

The effect of debranching on leaf and stem growth was significant (Table 2). Generally stem and leaf growths were decreased with increasing debranching. Leaf number, leaf fresh and dry weights, leaf-lobe fresh and dry weights, petioles fresh and dry weights, stem plus branch fresh and dry weights were the smallest after removal of three branches (D_3) (417.70, 2082.00g, 411.30g, 1220.00g, 261.60g, 861.70g, 149.70g, 1601.00g, 459.70g and 10.84m^2 for leaf number, leaf fresh weight, leaf dry weight, leaf-lobe fresh weight, leaf-lobe dry weight, petiole fresh weight, petiole dry weight, stem plus branch fresh weight, stem plus branch dry weight, leaf-lobe area, respectively). Control plant (D_0) had greater leaf number, leaf fresh and dry weights, leaf-lobe fresh and dry weights, petioles fresh and dry weights, stem plus branch fresh and dry weights, leaf-lobe area than D_1 (1-branch removal) and D_2 (2-branch removal).

Table 2. Effect of shoot number, debranching and their interaction on leaf and stem growth at 245 days after planting (DAP) in Cassava

Treatment	Leaf per plant	Leaf mass/plant (g)		Leaf-lobes mass/plant (g)		Petioles mass/plant (g)		Stem+ branch mass/plant (g)		Leaf-lobe area/plant (m^2)
		Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry	
Shoot no. (S)										
1-shoot (S_1)	410.98b	2066.43b	408.95b	1212.05b	257.47b	856.09b	146.49b	1671.91b	522.78b	10.77b
2-shoot (S_2)	676.46a	3899.88a	711.85a	1714.46a	490.50a	1615.49a	281.31a	3277.19a	1023.48a	20.32a
Level of sign.	**	**	**	**	**	**	**	**	**	**
LSD $_{0.05}$	17.401	82.314	16.32	48.58	12.03	34.35	5.964	35.84	11.81	0.472
Debranching (D)										
Control (D_0)	771.80a	3875.0a	768.3a	2276.0a	488.1a	1608.0a	275.2a	3402.0a	1080.0a	20.23a
1-branch (D_1)	658.60b	3319.0b	656.3b	1800.2b	412.2b	1374.0b	239.5b	2772.0b	879.3b	17.29b
2-branch (D_2)	526.80c	2657.0c	525.7c	1557.0c	334.0c	1100.0c	291.1c	2123.0c	673.5c	13.83c
3-branch (D_3)	417.70d	2082.0d	411.3d	1220.0d	261.6d	861.7d	149.7d	1601.0d	459.7d	10.84d
Level of sign.	**	**	**	**	**	**	**	**	**	**
LSD $_{0.05}$	24.61	116.40	23.08	68.70	17.01	48.52	8.43	50.67	16.70	0.668
Interaction (S×D)										
S_1D_0	489.75d	2445.58 e	484.98 e	1436.55d	308.11 e	1017.76 e	176.90 e	2376.35 d	755.62 d	12.768 e
S_1D_1	455.25 d	2494.97 e	453.33 e	1345.70 d	288.62 f	950.53 e	165.71 e	1831.70 e	581.01 f	11.960 e
S_1D_2	418.00 e	2108.29 f	417.14 f	1235.54 e	265.00 f	872.49 f	152.14 f	1415.41 g	448.96 g	10.982 f
S_1D_3	280.91 f	1416.87 g	280.35 g	830.39 f	178.10 g	586.55 g	102.26 g	1064.16 h	305.52 h	7.380 g
S_2D_0	1053.82a	5304.88 a	1051.66 a	3115.08 a	668.14 a	2200.38 a	383.56 a	4427.84 a	1404.42 a	27.68 a
S_2D_1	862.00b	4342.82 b	859.22 b	2545.72 b	545.85 b	1797.74 b	313.38 b	3712.46 b	1177.58 b	22.62 b
S_2D_2	635.00 c	3205.40 c	634.18 c	1878.50 c	402.88 c	1326.92 c	230.10 c	2831.08c	898.04 c	16.68 c
S_2D_3	554.50d	2764.42 d	542.34 d	1609.52 d	345.12 d	1136.92 d	198.20 d	2137.36 e	613.88 e	14.30 d
Level of sign.	**	**	**	**	**	**	**	**	**	**
LSD $_{0.05}$	34.80	164.60	32.64	97.16	24.06	68.68	11.93	71.66	23.61	0.945

*, **: indicates significance at P≤0.01 and P≤0.05, respectively. In a column within a particular treatment, figures followed by different letters are significant at P≤0.05.

leaf number, leaf fresh and dry weights, leaf-lobe fresh and dry weights, petiole fresh and dry weight, leaf-lobe area, respectively) than that of 1-shooted (S_1) one (410.98, 2066.43g, 408.95g, 1212.05g, 257.47g, 856.09g, 146.49g, 1671.91g, 522.78g and 10.77 m^2 for leaf number, leaf fresh weight dry weights, leaf-lobe fresh and dry weights, petiole fresh and dry weights, leaf-lobe area, respectively).

The effect of debranching on leaf and stem growth was significant (Table 2). Generally stem and leaf growths were decreased with increasing debranching. Leaf number, leaf fresh and dry weights, leaf-lobe fresh and dry weights, petioles fresh and dry weights, stem plus branch fresh and dry weights were the smallest after removal of three branches (D_3) (417.70, 2082.00g, 411.30g, 1220.00g, 261.60g, 861.70g, 149.70g, 1601.00g, 459.70g and 10.84m^2 for leaf number, leaf fresh weight, leaf dry weight, leaf-lobe fresh weight, leaf-lobe dry weight, petiole fresh weight, petiole dry weight, stem plus branch fresh weight, stem plus branch dry weight, leaf-lobe area, respectively). Control plant (D_0) had greater leaf number, leaf fresh and dry weights, leaf-lobe fresh and dry weights, petioles fresh and dry weights, stem plus branch fresh and dry weights, leaf-lobe area than D_1 (1-branch removal) and D_2 (2-branch removal).

Interaction effects of shoot number and debranching on leaf and stem growth were also significant (Table 2). The trend of leaf and stem growth was decreased with increasing debranching in both S_1 and S_2 with the magnitude of decrement was much greater in the latter than in the former. Leaf number was drastically decreased as expected when three branches were removed in both S_1 and S_2. Similar trend was also observed in case of leaf fresh and dry weights, leaf-lobe fresh and dry weights, petiole fresh and dry weights, stem plus branch fresh and dry weights and leaf lobe-area.

Table 3. Effect of shoot number, debranching and their interaction on storage root and fibrous root yield at 245 days after planting (DAP) in Cassava

Treatment	Storage root			Storage root mass/plant (kg)		Fibrous root			Fibrous root mass/plant (g)	
	No./plant	Dia (cm)	Length (cm)	Fresh	Dry	No./plant	Dia (cm)	Length (cm)	Fresh	Dry
Shoot no. (S)										
1-shoot (S1)	16.65	3.01	19.36	2.66	1.10	81.83a	0.029	14.63	23.72	11.20
2-shoot (S2)	16.77	3.00	19.71	2.73	1.13	80.79b	0.029	14.75	23.53	11.15
Level of sign.	NS	NS	NS	NS	NS	*	NS	NS	NS	NS
$LSD_{0.05}$	-	-	-	-	-	1.984	-	-	-	-
Debranching (D)										
Control (D0)	18.88a	3.294a	22.51a	3.70a	1.54a	68.46d	0.0275b	13.088c	16.46d	7.78c
1-branch (D1)	18.04a	3.303a	20.13b	3.19b	1.32b	73.42c	0.0273b	14.598b	19.69c	9.29b
2-branch (D2)	15.46b	3.122b	20.41b	2.54c	1.05c	86.29b	0.0289b	15.308a	25.55b	12.07b
3-branch (D3)	14.46b	3.308a	15.09c	1.34d	0.54d	97.08a	0.032a	15.387a	32.80a	15.56a
Level of sign.	**	**	**	**	**	**	**	**	**	**
$LSD_{0.05}$	1.103	0.235	1.508	0.211	0.096	2.806	0.0039	0.521	1.309	0.635
Interaction (S×D)										
S1D0	18.25a	3.38 a	22.76	3.74 a	1.55 a	68.25 e	0.0276	12.98 d	16.20 d	7.65 d
S1D1	18.00 a	3.40 a	19.59	3.17 b	1.32 b	73.25 d	0.028	14.38 c	19.72 c	9.31 c
S1D2	15.92b	3.12 a	20.63	2.54 c	1.13 c	88.67 b	0.029	15.01 bc	25.91b	12.24 b
S1D3	14.42 b	2.15 b	14.44	1.15 e	0.47 d	97.17 a	0.0313	16.16 a	33.03 a	15.60 a
S2D0	19.50 a	3.20 a	22.26	3.67 a	1.53 a	68.67 e	0.0273	13.19 d	16.72 d	7.90 d
S2D1	18.08 a	3.21 a	20.67	3.20 b	1.33 b	73.58 d	0.0267	14.79 bc	19.66c	9.28 c
S2D2	15.00 b	3.13 a	20.19	2.53 c	1.05 c	83.92 c	0.0285	15.61 ab	25.20b	11.91 b
S2D3	14.00 b	2.47 b	15.73	1.53 d	0.60 d	97.00 a	0.0330	15.39 abc	32.56a	15.51 a
Level of sign.	*	*	NS	**	*	**	NS	*	**	**
$LSD_{0.05}$	1.560	0.332	-	0.298	0.136	3.968	-	1.042	1.852	0.907

*, ** indicates significance at $P \leq 0.01$ and $P \leq 0.05$, respectively, NS = not significant. In a column within a particular treatment, figures followed by different letters are significant at $P \leq 0.0$

Storage and fibrous root yield: Shoot number had little effect on storage and fibrous root yield (Table 3). Fibrous root number (81.83) was higher in 1-shooted (S_1) plant than that of 2-shooted (S_2) one (80.79). Storage and fibrous root yield was significantly influenced by de-branching (Table 3). Incase of storage root; root number, root fresh and dry weights decreased after removal of three branches (D_3) (14.46, 15.09cm, 1.34kg, and 0.54 kg for storage root number, storage root length, storage root fresh and dry weights, respectively) than 2-branch removal (D_2), 1-branch removal (D_1) and control (D_0). Diameter of storage root was decreased with increasing debranching up to D_2 followed by an increase at D_3. Control plants (D_0) had higher storage root number, root length, root fresh and dry weights than D_1 and D_2. Incase of fibrous root; root number, root diameter, root length, root fresh and dry weights were also higher at D_3 (97.08, 0.032cm, 15.38cm, 32.80g and 15.56g for root number, root diameter, root length, root fresh and dry weight, respectively). Control plants (D_0) had lower fibrous root number, root diameter, root length, root fresh and dry weights than D_1 and D_2. Interaction effects of shoot number and debranching on storage and fibrous root yield were significant (Table 3). Incase of storage root; root number, root diameter, root length, root fresh and dry weights decreased at D_3 both in S_1 and S_2. Incase of fibrous root; root number, root length, root fresh and dry weight decreased at control plants both in S_1 and S_2. Storage root yield (both fresh and dry weights) decreased with increasing debranching in both in S_1 and S_2 with the magnitude of root yield reduction was much greater in S_1 than S2.

Correlation: The correlation co-efficient (r) values between storage root yield with yield attributes and also with morphological characters are shown in the Table 4. Results revealed that Fresh storage root weight was positively and significantly related with total dry mass (TDM) and TDM in turn was also significantly correlated with leaf and branch production (Table 4).

Discussion

Canopy structure: Cassava plant consists of a mainstem bearing 1-3 primary (1°) branches and 1° branches may again fork into lateral branches producing several reproductive branches on top of the 1^0 branches (Purseglove, 1988; Islam *et al.*, 2008; Rahman and Haque, 1983). Canopy structure is determined by variety, location, cultivation protocol and management practices. In the current experiment, the effects of shoot number and debranching on morphology, and stem and leaf growth were investigated (Tables 1 and 2). Results showed that shoot number had little effect on morphological characters (Table 1) but it significantly influenced leaf and stem growth with 1.5 to 2-fold leaf and stem growth in the 2-shooted (S_2) compared to 1-shooted plant (S_1) (Table 2). Debranching resulted in decreased branch number and, hence, leaf area, and leaf and stem weights were decreased with increasing degree of debranching. Ayoola and Agoboola (2003) also reported similar results. Results of interaction effect of shoot number (S_1 & S_2) and debranching (control, D_0; 1-branch removal, D_1; 2-branch removal, D_2 and 3-branch removal, D_3) on canopy, leaf and stem growth revealed that 2-shooted (S_2) with control

(D_0) plant had vigorous canopy structure (Tables 1 and 2). Both in S_1 and S_2, leaf number, leaf area (LA), leaf and stem weights were decreased with increasing magnitude of debranching. The degree of reduction being greater in S_2 than S_1. For example, LA was decreased by 42.20% in S_1D_3 where as it was 48.34% in S_2D_3 (Table 2).

Table 4. Correlation between morphological characters and yield attributes at 245 days after planting (DAP) in Cassava

(1) Leaf number/plant	1	2	3	4	5	6	7	8	9	10
	1									
(2) Leaf-lobe fresh weight/plant (g)	0.89**	1								
(3) Stem plus branch fresh wt/plant (g)	0.81**	0.46*	1							
(4) Leaf-lobe area/plant (cm2)	0.82**	0.47*	0.98**	1						
(5) Storage root number/plant	0.50*	0.29	0.61**	0.58**	1					
(6) Storage root diameter (cm)	0.32	0.18	0.44	0.40	0.65**	1				
(7) Storage root fresh wt. (kg)	0.48*	0.30	0.62**	0.57**	0.86**	0.90**	1			
(8) Storage root dry wt. (kg)	0.48*	0.30	0.62**	0.56**	0.86**	0.89**	1.00	1		
(9) Fibrous root fresh wt./plant (g)	-0.46*	-0.27	-0.62**	-0.55**	-0.88**	-0.84**	-0.97**	-0.97**	1	
(10) TDM/plant	0.45*	0.28	0.57**	0.54**	0.81**	0.80**	0.94**	0.93**	-0.92**	1

*, **: Significant at P<0.05 and P<0.01, respectively

Root yield: In root crop, storage root (tuber) yield is determined by the tuber number and size (Islam *et al.* 2008). Although leaf and stem growth was almost 2-fold in S_2 compared to S_1 but that was not reflected in the storage root yield. In case of debranching, storage root yield decreased with increasing order of branch removal and the trend was similar to that of leaf and stem growth (Tables 1-3). Results of interaction effect of shoot number and de-branching on root yield revealed that the storage root mass decreased with increasing order of branch clipping both at S_1 and S_2, the magnitude being greater in the former than in the later. Similar results were also observed by Ayoola and Agboola (2003). Islam *et. al.* (2008) also reported that higher tuber yield could be achieved with 3-branches compared to 1- and 2-branches. Results of correlation study revealed that storage root yield could be increased by increasing storage root number and size since they were positively correlated.

It may be concluded that debranching decreased root yield with the highest tuber yield was observed in control plants (average of 3.74 kg per plant). Further, increased number of storage roots per plant with wider root appeared to be responsible for good storage root yield per plant in Cassava.

References

Ayoola, O.T. and Agboola, A.A. 2003. Influence of cassava planting patterns and pruning methods on crop yield in a cassava-based cropping system. African Crop Sci. J.,12(2): 115-122.

Castellanos, V. H. 1981. " Comportmiento de le yucca (*Manihot esculenta* Crantz) some tida a una poda parcial y cultivada en a sociacion con frijol comun arbustivo y voluble (*Phaseolus vulgaris* L.)" tesis Mg. Sci. CATIE, Turrialba, Costa Rice. p. 104.

Granda, F., Rodriguez, G., Mayor, F. and Cristo, A. C. 2000. Morphological characterization of 16 clones of cassava (*Manihot esculenta* Crantz). Field Crops Res., 21(2): 253-261.

Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedures for Agricultural Research. 2"[d] edi. John Wiley and Sons. pp. 207-215.

Islam, A., Islam, A.T.M., Shaha, S., Mostafa, M.G. and Fakir, M.S.A. 2008. Branch number effects on tuber yield of two Cassava morphotypes. Bangladesh J. Agriculturist, 1(1): 1-6.

Islam, A.T.M.T., Prodhan, A.K.M.A. and Fakir, M.S.A. 2007a. Morphological differences in three cassava morphotypes. J. Agrofor. Environ.,1(2): 115-118.

Islam, A.T.M.T., Abdullah, S., and Fakir, M. S. A. 2007b. Growth and Yield in two Cassava Morphotypes. J. Agrofor. Environ., 1(2): 21-24.

Lima, P.S.C., Vasconcelos, L.F.L. and Azevedo, J.N. 2000. Evaluation of cultivars and harvest time for cassava stem and leaf production in Piaui, Brazil. Cientifica., 28 (1/2): 57-67

Okoli, P.S.O. and Wilson, G.F. 1982. Cropping system agronomy. IITA Annual Report for 1981, Ibadan Nigeria. p. 4-8.

Purseglove, J.W. 1988. Tropical Crops. Dicotyledons I. Longman, London, London. p. 174-176.

Rahman, A. and Haque, A. 1983. Studies on the morphological characteristics, yield and nutritive value of seven varieties of sweet potato. Bangladesh Hort., 11(2): 1-8.

Ramanujam, T. 1985. Leaf density profile and efficiency in partitioning dry matter among high and low yielding cultivars of cassava (*Manihot esculenta* Crantz). Field Crops Res., 10: 291-303.

Rani, A. R. B. and Ramaswamy, N. 2001. Evaluation of open pollinated clones of cassava for growth and yield parameters. Prog. Hort., 33(1): 57-6

Veltkamp, H. J. 1985. Partitioning of dry matter in cassava. Agric. Univ. Wageningen Papers, 85: 62-72.