

Morphological differences in three Cassava MorphotypesA. T. M. T. Islam¹, A. K. M. A. Prodhan and M. S. A. Fakir

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Abstract: Some important qualitative and quantitative morphological characters of three Cassava Morphotypes viz., Philippine, Nagra and Sundori were studied at maturity, 260 days after planting. Qualitative characters, external colour and branching habit, apical leaf color, petiole colour, external colour, texture and shape of storage root; and quantitative characters, plant height, stem diameter, number of leaves/plant, diameter and length of storage root, diameter of fibrous root, and fresh and dry mass of leaves, stem and storage root of the three Morphotypes differed from each other. It appears that three Morphotypes can be identified on the basis of petiole colour and storage root characters.

Key words: Petiole colour, Storage root, Morphology, *Manihot esculenta*.

Introduction

Cassava (*Manihot esculenta* Crantz.) is a perennial shrub of Euphorbiaceae. It is commonly known as 'simul alu' to tribal people in Bangladesh. Tribal people of Modhupur, Netrokona, Chittagong Hill tracts and other areas cultivate some cassava and consume locally. Cassava is an important tropical root crop and food for about 500 million people (Cock, 1985). Some important general morphological features was described by Purseglove (1988). Leaves are spirally arranged with 2/5 phyllotoxy. Petiole is larger than lamina. Lamina is deeply palmately divided usually with 5-7 lobes. Lobes are obovate-lanceolate 4-20×1-6 cm. Stem cuttings are used for propagation. Branches are slender with leaves usually toward the apex. Tuberos root or edible storage roots develop as swelling from some of the adventitious fibrous roots of the stem cutting below ground. Cassava is a monoecious plant and its inflorescence is produced at the reproductive branches. Male flowers develop near the tip, while female flowers develop closer to the base of the inflorescence. The mature fruit is a capsule with a diameter of 1-1.5 cm, and six narrow longitudinal ridges or wings along which it naturally splits open when dry. The cassava seed is oval and 0.7-1.0 cm long. (Purseglove, 1988). Morphological characterization of 16 clones of cassava was investigated abroad (Granda *et al.*, 2000). The qualitative characters that contributed most of the variation were external colour, epidermis, stem colour, external root colour, root flesh colour, petiole colour and flowering (Granda *et al.*, 2000). There is only one report available regarding the Morphotypes of cassava in Bangladesh (Islam, 2004). For the first time we report variation of different Morphotypes on the basis of external morphological features of root, stem and leaf.

Materials and Methods

The study was conducted at the field laboratory of the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh between March and December, 2003. The soil was silty loam and poorly drained. In addition to recommended dose of fertilizers, The branching habit of stem varied markedly among the three Morphotypes. The branching started 40-60

well-decomposed cow dung (1656 kg/ha) was also applied during initial land preparation. The entire amount of urea, TSP and MP at the rate of 83, 62 and 62 kg/ha, respectively, was applied at the time of final land preparation. The stem cutting of the three Cassava Morphotypes ('Philippine', 'Nagra' and 'Sundori' as are called by tribal people) were planted in a randomized complete block design (RCBD) with three replications. The size of the unit plot was 3.6 m × 3.6 m and 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 12 cm long with 6 nodes) cutting stalks (stems) of 12 months old cuttings were planted on March 28, 2003. The stalks were planted with an angle to about 30°, placing two-thirds of the cutting in the soil. The distance between two stalks was 90 cm and 2 stalks were planted in each hole. There were 16 plants/plot (12.96 m²). The cuttings were watered after planting and continued for several days until their establishment.

Crop sampling and data collection: Qualitative morphological characters of external colour, texture of stem, leaf and storage root were observed. Quantitative external morphological characters such as plant height stem base diameter at 10 cm (d₁₀), length and diameter of storage and fibrous root, number of leaf, length and width of leaf-lobe, number of storage and fibrous root/ plant were recorded from 5 plants/plot at 260 days after planting (DAP). Fresh weight of leaf-lobe, petiole, stem and storage root was weighed per plant basis. After oven drying (80±2°C for 48 h), dry mass of the above plant parts were also recorded. The collected data were analyzed and mean differences were evaluated by Duncan's New Multiple Range Test (Gomez and Gomez, 1984).

Results and discussion

Morphological characters (Qualitative): The three Morphotypes showed wide variation in stem characters (Table 1, Plate 1).

cm above the soil in Philippine, while stem profusely branched 10 cm above the soil in Sundori and little or

no branching in Nagra (Table 1, Plate 1). There were wide variations among the Morphotypes in leaf characters (Table 1, Plate 1). The apical leaf colour of Philippine and Nagra was dark green while it was light green in Sundori (Table 1). The most distinguishable variation was also observed in petiole colour among the three Morphotypes. The petiole colour was red, yellowish green and light green in Philippine, Nagra, and Sundori Morphotypes, respectively. There was also variation in the colour of mature leaves among the three Morphotypes. Dark green leaf was observed in Philippine and light green was noted in Nagra and Sundori (Table 1). External colour and texture of storage roots of the three Cassava Morphotypes showed wide variation (Table 1, Plate 2). The colour

and texture of storage root was dark brown and rough in Philippine, brown and smooth in Nagra, and light brown and smooth in Sundori. Some of the morphological characters of cassava observed in the current study agree with the description of Pursel (1988). Further, distinction between Morphotypes on the basis of qualitative attributes such as branching pattern, colour of stem and petiole and storage root characters are also similar with the findings of Granda *et al.*(2000) who observed contributory variation between sixteen clones of cassava on the basis of external stem, petiole and root colour. Islam (2004) also observed similar variation in the cassava Morphotypes.

Table 1. Some important qualitative morphological features of stem, leaf, storage root in three Cassava Morphotypes at 260 days after planting.

Morphotype	Morphological feature								
	Stem			Leaf			Storage root		
	External colour	Branching habit	Apical Stem colour	Apical colour	Petiole colour	Colour at Maturity	External colour	External texture	Shape
Philippine	Brown to redish yellow	Straight branching started 40-60 cm above the soil	Green yellow to dark green	Dark green	Red	Dark green	Dark brown	Rough	Conical-cylindrical
Nagra	Brownish-green to green	Straight, little branching	Light green to dark green	Dark green	yellowish green	Light green	Brown	Smooth	Fusiform
Sundori	Light yellow to light green	Branching started 10 cm above the base	Dark green	Light green	Light yellow	Light green	Light brown	Smoothen than Nagra	Cylindrical



Plate 1. Canopy structure and branching habit in three Cassava Morphotypes (A: Philippine, B: Nagra, C: Sundori). Scale is 1m.

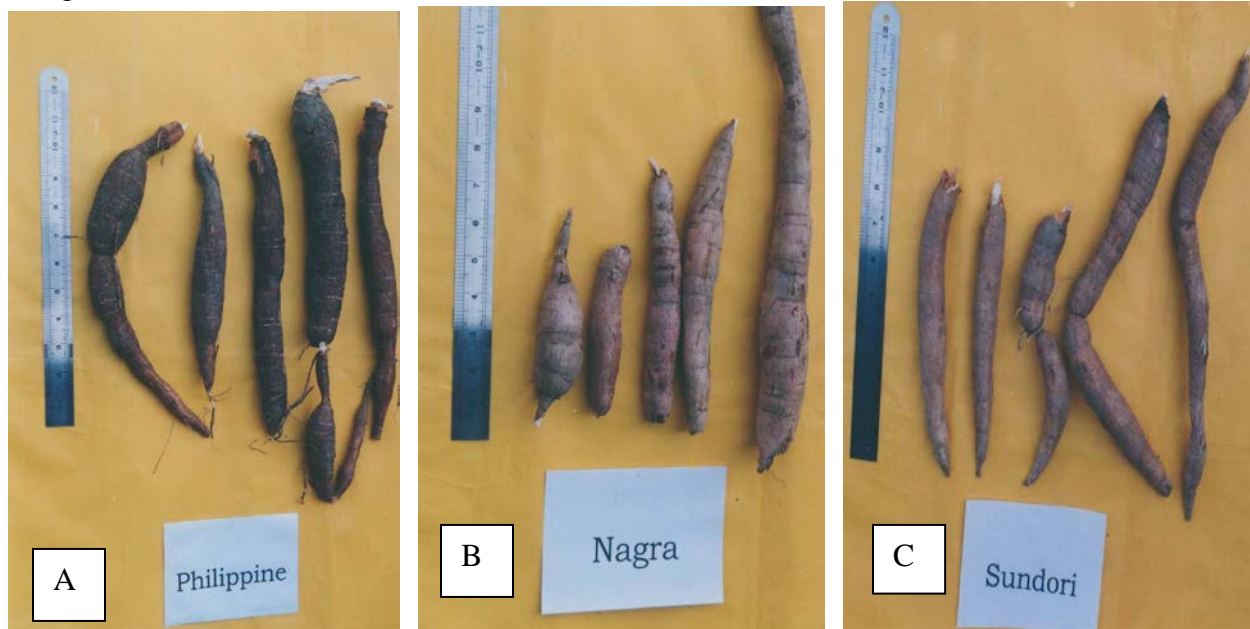


Plate 2. Storage root of three Cassava Morphotypes (A: Philippine, B: Nagra, C: Sundori). Scale is 1m.

Morphological characters (Quantitative): Significant variation in plant height was found among the three Morphotypes (Table 2). The plant height was greater in Sundori (1.5 m) than in the Philippine (1.2 m) at maturity, 260 days after planting (DAP) (Table 2). A significant variation was found in diameter of mature stem (d_{10}) among the three Morphotypes at 260 DAP (Table 2). The d_{10} was greater (2.2 cm) in Philippine than in the Nagra and Sundori (1.6 cm). There was significant variation in number of leaves/plant among the Morphotypes (Table 2). It was greater in Sundori (94) than in Philippine and Nagra (average of 52) (Table 2). The length and width of central leaf-lobe was greater in Philippine (18.67 and 5.33 cm, for length and width respectively) than in Nagra and Sundori (Average of 13.67 and 3.18 cm, for length and width respectively) (Table 2). The shape of storage roots was also different. Conical-cylindrical was in Philippine, fusiform in Nagra, cylindrical in Sundori (Table 1, Plate 2). In general all the Morphotypes produced 5 to 6 storage roots (Table 2). The mean length of storage root varied between 15.5 and 22.4 cm (Table 2). The maximum mean length of storage root was recorded in the genotype Philippine (22.4 cm) and the minimum in Nagra (15.5 cm). The diameter of storage roots varied markedly among the Morphotypes (Table 2). The highest diameter of storage root was recorded in the genotype Philippine (3.8 cm) and lowest was in Nagra (2.5cm) with being intermediate in the Sundori (3.2 cm) (Table 2). Significant variation was also observed in diameter of fibrous root (Table 2). It was greater in Philippine (0.5cm) than in the other two Morphotypes (average of 0.4 cm). There was significant variation in dry weight of leaves/plant

between Morphotypes (Table 3). It was significantly ($P \leq 0.05$) greater in Sundori (73.9g) than in the other two Morphotypes (average of 39.1g). Fresh weight of leaves/plant had a trend similar to that of dry weight of leaves/plant. Leaf-lobe mass/plant and petiole mass/plant followed a trend similar to that of dry weight of leaves/plant (Table 3). Dry weight of stem significantly varied between the three Cassava Morphotypes, and it was greater in Sundori (167.7g) than in the Philippine (74.6g) and Nagra (52.40g) (Table 3). Fresh weight of stem followed a trend similar to that of dry weight of stem. There was a wide variation in yield or fresh weight of storage root/plant among the Morphotypes at maturity (Table 3). The genotype Philippine produced the highest fresh weight of storage roots/plant (920.80g) and Nagra produced lowest (303.3g) with being intermediate in Sundori (610g). Dry weight of storage root had a similar pattern like fresh weight, and it was greater in Philippine (363.3g) than in the Sundori (221.7g) and Nagra (126.5 g). Significant difference in dry weight of fibrous root was also observed (Table 3).

The maximum dry weight of fibrous root/plant was observed in the Morphotypes Philippine (9.5g) which was statistically similar with Sundori (8.9g). The lowest dry weight of fibrous roots/plant was observed in the Morphotypes Nagra (6.7g). The morphological features observed in the present study were similar to the description of Islam (2004). From the above study, it was found that there was a distinct variation among the three Cassava Morphotypes. Profuse branching habit was found in Sundori and little or no branching in Nagra.

Table 2. Some important quantitative morphological characters of shoot and root at 260 days after planting in three Cassava Morphotypes.

Morpho-type	Plant height (m)	Stem diameter at d ₁₀ (cm)	Leaf			Storage root			Fibrous root		
			No./plant	Central lobe Length (cm)	Central lobe width (cm)	Quantity/plant (no.)	Length (cm)	Diame-ter (cm)	Quantity /plant (no.)	Length (cm)	Diame-ter (cm)
Philippine	1.2b	2.2a	57.3b	18.67a	5.33a	5.0a	22.4a	3.8a	18.0a	20.0a	0.5a
Nagra	1.3ab	1.6b	46.7b	12.67b	2.83b	5.3a	15.5c	2.5c	15.7a	18.9a	0.4b
Sundori	1.5a	1.6b	94.0a	14.67b	3.517b	6.3a	19.7b	3.2b	16.0a	17.3a	0.4b

* In each column, figures bearing dissimilar letter (s) are significantly different at $P \leq 0.05$ by DMRT.

Table 3. Fresh and dry mass of leaf, stem and root at 260 days after planting in three Cassava Morphotypes.

Morpho-type	Leaf-lobe mass/plant (g)		Petiole mass/plant (g)		Leaf mass/plant (g)		Stem mass/plant (g)		Storage root mass/plant (g)		Fibrous root mass/plant (g)	
	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
Philippine	104.8b	30.9b	45.8b	12.0b	150.6b	42.9b	182.25b	74.6b	920.8a	368.3a	16.45a	9.5a
Nagra	80.5b	26.5b	32.6b	8.9b	113.1b	35.3b	98.86c	52.4c	303.3c	126.5c	11.63b	6.7b
Sundori	159.8a	55.5a	82.8a	18.4a	242.6a	73.9a	284.23a	167.7a	610.0b	221.7b	14.96a	8.9a

In each column, figures bearing dissimilar letter (s) are significantly different at $P \leq 0.05$ by DMRT.

Petiole colour was red in Philippine, yellowish green in Nagra while light green in Sundori. The external colour of storage root of Philippine was dark brown, while brown and light brown in the Nagra and Sundori, respectively. External texture of storage root in Philippine was rough and very smooth in Sundori.

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