

## CHARACTERIZATION OF MAIZE (*Zea mays* L.) LANDRACES OF BANDARBAN IN KHARIF SEASON

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### ABSTRACT

An experiment was carried out under field conditions to characterize 10 maize landraces during the period from March 2019 to July 2019 in Kharif season at the research field of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. Planting materials of the landraces were collected from different locations of Bandarban hill district. The landraces were characterized in terms of plant growth and yield parameters on morphological traits. Each of the landraces were termed as a variety and was named by the color of the grains. As such the varieties (V<sub>1</sub>) = White, V<sub>2</sub>= Off white, V<sub>3</sub> = Purple, V<sub>4</sub>= Black, V<sub>5</sub>= Red, V<sub>6</sub>= Yellow, V<sub>7</sub>= Pink, V<sub>8</sub>= Yellow and Brown scattered, V<sub>9</sub>= Brown and V<sub>10</sub>= Variegated. High level of significance of variation was found among the landraces. Maximum time (67.67 days) for flowering was taken by V<sub>10</sub> and minimum time (53.67 days) was taken by V<sub>1</sub>. V<sub>8</sub> took highest time (128.67 days) and V<sub>1</sub> took lowest time (105 days) to mature. Tallest plant was found in V<sub>10</sub> (210.50 cm) and shortest plant was found in V<sub>6</sub> (160 cm). Varieties differed in leaf number, leaf length, leaf width, root length, root spread circumference and tassel length. The maximum cob length (28.4 cm) was recorded from V<sub>1</sub> and the minimum from V<sub>3</sub> (18.25 cm). The highest cob circumference (16.70 cm) was in V<sub>4</sub> whereas, the lowest (10 cm) was in V<sub>10</sub>. V<sub>3</sub> had the maximum grain rows cob<sup>-1</sup> (16.17) whereas, V<sub>6</sub> had the minimum (10.75). V<sub>1</sub> exhibited the maximum number of grains row<sup>-1</sup> (26.70) and V<sub>9</sub> had the minimum (13.50). Highest number of grains per cob was counted at V<sub>1</sub> (335.17) and lowest number was at V<sub>9</sub> (164.31). Varieties also differed in stem dry matter, leaf dry weight, shell weight and chaff weight. The greatest grain weight per plant was attained in V<sub>1</sub> (62.55 g) while, the lowest was in V<sub>6</sub> (27 g). V<sub>1</sub> showed the maximum 100 grains weight (23.36 g) and V<sub>6</sub> showed the minimum (14.94 g). V<sub>1</sub> showed the maximum grain yield (3.10 t ha<sup>-1</sup>) and V<sub>6</sub> showed the lowest grain yield (1.28 t ha<sup>-1</sup>). V<sub>8</sub> presented the highest stover yield (6.89 t ha<sup>-1</sup>) and V<sub>6</sub> the lowest (4.40 t ha<sup>-1</sup>). Highest biological yield (8.92 t ha<sup>-1</sup>) was exhibited by V<sub>4</sub> and lowest biological yield (5.68 t ha<sup>-1</sup>) was exhibited by V<sub>6</sub>. V<sub>1</sub> showed the maximum harvest index (40.72%) while V<sub>5</sub> showed the minimum harvest index (19.28%).

**Keywords:** growth parameters, landraces, maize, morphology, yield and yield components.

### INTRODUCTION

Maize (*Zea mays*, L.) is a cereal crop belonging to the family Poaceae. In Bangladesh maize was introduced through Christian Missionaries after Portuguese establishment in Chittagong around 1528 (Kumar and Sachan, 1993). From that time the tribal people in the hilly areas of Chittagong (Chittagong hill tracts, CHT) have been growing local landraces in jhum (mixed cropping) system specially in Bandarban (Chakma and Ando, 2008; Ullah *et al.*, 2017a; Ullah *et al.*, 2017b; Ullah *et al.*, 2012). Modern variety maize cultivation got attention at late twentieth century in Bangladesh. The prolonged and significant loss of genetic variability of the indigenous landraces in most crops occurs due to the inclusion of the modern varieties and land degradation. But maize landraces are considered to be a valuable resource for genetic diversity. So, conservation of the landraces is to be maintained (Yadav *et al.*, 2006).

Despite the inclusion of modern varieties of maize in Bangladesh cropping system, the hill peoples still grow local landraces to consume its grains (Akbar *et al.*, 2016; Ullah *et al.*, 2016). Many land races are available in the hilly areas of the southeast. However, their yield performance has not been yet evaluated and compared yet substantially. Based on the above facts the study was conducted to evaluate the morphological traits and yield performance of some local land races of maize.

### MATERIALS AND METHODS

The experiment was conducted during the period from 14 March 2019 to 21 July 2019 at the Agronomy field of Sher-e-Bangla Agricultural University (SAU). The experimental site was

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geographically situated at 23°77' N latitude and 90°33' E longitude at an altitude of 8.6 meter above sea level. The soil belonged to the Agro-ecological zone (AEZ) of “The Madhupur Tract”, AEZ-28. The climate of the experimental site was subtropical, characterized by the pre-monsoon period or hot season from March to April and the monsoon period from May to October (Edris *et al.*, 1979). The silty-clay soil of the site had pH 5.6, organic carbon 0.45%, organic matter 0.78%, N 0.077%, available P 20 ppm, exchangeable K 0.10 mel. eq. /g soil and available S 45 ppm.

The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. The field was divided into 3 blocks and 30 plots. The size of each unit plot was 3.6 m<sup>2</sup> (2 m × 1.8 m). Each plot had 30 plants. Distance maintained between blocks were 1 m. Row to row and plant to plant distances maintained were 0.60 m and 0.20 m respectively. The land was prepared to obtain good tilth by several ploughing, cross ploughing and laddering. Weeds and stubbles were removed; larger clods were broken into small particles and finally attained into a desirable tilth to ensure proper growing conditions.

Recommended doses of well decomposed cow dung manure and chemical fertilizers were applied and mixed well with the soil uniformly.

The indigenous maize landraces are cultivated in “Jhum cultivation” at hilly areas in Kharif season. Seeds of ten local maize landraces were collected from various locations of Bandarban district. Each of the landraces were termed as a variety based on the grain colour of the individual variety and as such V<sub>1</sub> (variety 1) meant for White, V<sub>2</sub> meant for Off white, V<sub>3</sub> meant for Purple, V<sub>4</sub> meant for Black, V<sub>5</sub> meant for Red, V<sub>6</sub> meant for Yellow, V<sub>7</sub> meant for Pink, V<sub>8</sub> meant for Yellow and Brown scattered, V<sub>9</sub> meant for Brown and V<sub>10</sub> meant for Variegated.

The dose of the applied fertilizer per hectare were cow dung 5 tons, urea 500 kg, TSP 250 kg, MoP 200 kg, gypsum 250 kg, zinc sulphate 10 kg and boric acid 7 kg. Fertilizer was applied following BARI (2016). Urea was applied by three installments. The entire cow dung, TSP, MOP, gypsum, zinc sulphate, boric acid and one third of the urea was applied at the time of final land preparation. The remaining amount of urea was applied as top dressing in two installments, respectively at 25 and 50 days after sowing following BARI (2019). The local maize seeds were sown in lines maintaining row-to-row distance and plant to plant distance of 70 cm and 25 cm, respectively on 14 March, 2019.

Various intercultural operations were done following BARI (2019). At 15 days after sowing, only the healthy plant was kept at a single hill removing the other one.

Regular field observations were made to see the whole growth stages of the crop. The mature cobs were harvested when the husk cover was completely dried and the grain base can be pulled easily from shell. The cobs of five randomly selected plants of each plot were separately harvested for recording yield attributes and other data. The harvested products were taken to the threshing floor and it was dried for about 3-4 days. Data were collected on days to flowering, days to harvesting, plant height (cm), number of leaves plant<sup>-1</sup> (no.), leaf length (cm), leaf width (cm), stem base circumference (cm), root length (cm), root area circumference (cm), yield contributing parameters, tassel length (cm), cob length (cm), cob circumference (cm), color of top kernel, number of rows cob<sup>-1</sup> (no.), number of grain rows<sup>-1</sup> (no.), number of grains cob<sup>-1</sup> (no.), grain weight plant<sup>-1</sup> (g), shell weight plant<sup>-1</sup> (g), chaff weight plant<sup>-1</sup> (g), 100 grains weight, yield parameters, grain yield (t ha<sup>-1</sup>), stover yield (t ha<sup>-1</sup>), biological yield (t ha<sup>-1</sup>) and harvest index (%).

Five cobs from each plot were selected randomly and the number of grain rows was counted and then the average result was recorded. The plant samples were dried in an oven at 70°C for 72 hours. The grain yield was adjusted at 14% moisture. The grain yield in t/ha was calculated using the following formula:

$$\text{Grain yield} = \frac{\text{Grain yield per meter square (kg)} \times 10000}{1000}$$

All the dry plant parts except grains are gathered to calculate stover yield. The stover yield was measured according to the following formula:

$$\text{Stover yield (t ha}^{-1}\text{)} = \frac{\text{Stover yield per meter square (kg)} \times 10000}{1000}$$

Final grain yield was adjusted at 14% moisture. Grain yield together with stover yield was regarded as biological yield and calculated with the following formula:

Biological yield (t ha<sup>-1</sup>) = Grain yield (t ha<sup>-1</sup>) + Stover yield (t ha<sup>-1</sup>)

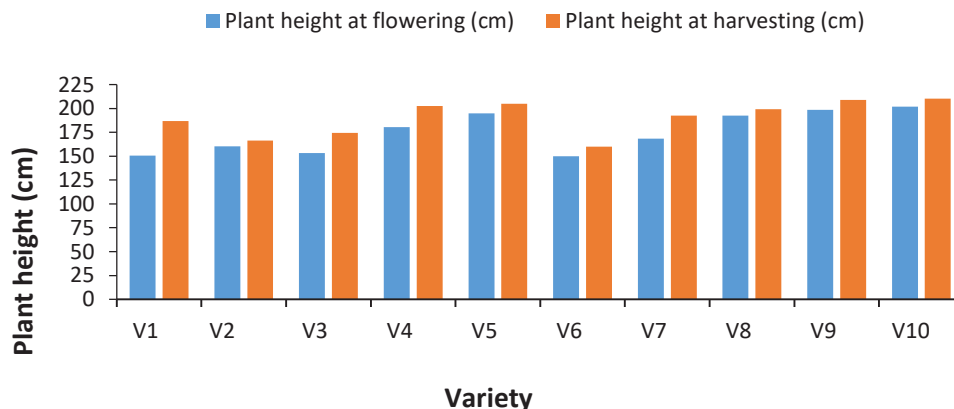
Harvest Index denotes the ratio of economic yield to biological yield and was calculated with the following formula:

$$\text{Harvest Index (\%)} = \frac{\text{Economic Yield (Grain weight)}}{\text{Biological yield (Total weight)}} \times 100$$

The collected data were compiled and analyzed following the analysis of variance (ANOVA) techniques using the software Statistix 10 (Statistix, 1985). The significant differences among the treatment means were compared by Least Significant Difference (LSD) at 5% levels of probability as per Gomez and Gomez (1984).

## RESULTS AND DISCUSSION

The plant height (Fig. 1) differed significantly among the varieties of the maize land races. At the flowering stage, V<sub>10</sub> showed the tallest plant (202 cm), while V<sub>6</sub> showed the shortest plant (150 cm). Similarly, at harvesting stage, V<sub>10</sub> showed the tallest plant (210.50 cm) and V<sub>6</sub> (160 cm) showed the shortest plant. Other landraces showed intermediate result at both flowering and harvesting stage. Ullah *et al.*, (2017b) found the landraces plant height ranges from 152 cm to 215 cm which almost close to the present study.



V<sub>1</sub> = White, V<sub>2</sub> = Off white, V<sub>3</sub> = Purple, V<sub>4</sub> = Black, V<sub>5</sub> = Red, V<sub>6</sub> = Yellow, V<sub>7</sub> = Pink, V<sub>8</sub> = Yellow and Brown scattered, V<sub>9</sub> = Brown and V<sub>10</sub> = Variegated

**Fig. 1.** Plant height of local maize landraces at flowering and harvesting stage (LSD value = 15.35 at flowering and 10.08 at harvesting)

At the tasseling stage, the highest number of leaves per plant (18) were observed in V<sub>8</sub> landrace followed by V<sub>10</sub> (17.67), V<sub>3</sub> (17.67), V<sub>7</sub> (16.67), V<sub>9</sub> (16) and V<sub>4</sub> (15.67), while lowest (13) in V<sub>1</sub> followed by V<sub>2</sub> (13.67), V<sub>6</sub> (15) and V<sub>5</sub> (15) (Table 1). The findings are in line with those of Dijk *et al.* (1999). Triveni *et al.* (2014) found that number of leaves per plant of maize significantly correlated with its variety and grain yield.

Maximum leaf length was noted in V<sub>2</sub> (95 cm) which was statistically similar to V<sub>8</sub> (91.5 cm) and V<sub>1</sub> (89.5 cm) and significantly different from all other landraces. Minimum was noted in V<sub>3</sub> (67.5 cm) (Table 1) which was statistically different from that of V<sub>2</sub>, V<sub>8</sub> and V<sub>1</sub>; and statistically similar to all other landraces. Silva *et al.* (2010) reported that the leaf length variation was observed in maize varieties and longest 90.6 cm was AG7000 and shortest 74.7 cm was in Master.

Maximum leaf width was found in V<sub>7</sub> (7.75 cm) which was statistically similar to all other landraces except V<sub>1</sub> and V<sub>2</sub> whereas, the minimum was found in V<sub>1</sub> (6 cm) (Table 1) which was statistically

similar to all other landraces except V<sub>1</sub>, V<sub>8</sub>, V<sub>4</sub> and V<sub>6</sub>. Other varieties showed intermediate value. Silva *et al.* (2010) observed a significant difference among the landraces according to leaf width.

At harvesting, number of leaves was the highest with V<sub>8</sub> which was at par with those of V<sub>3</sub>, and V<sub>9</sub>. The leaf length was the longest with V<sub>2</sub>, which however, was statistically similar to those of V<sub>1</sub> and V<sub>8</sub>. The leaf width was the widest in the landraces of V<sub>7</sub> which was statistically identical with those of V<sub>5</sub>, V<sub>6</sub> and V<sub>8</sub>.

Results showed that the variety V<sub>10</sub> took the maximum time (67.67 days) for flowering which was statistically similar with V<sub>8</sub> (66.67 days) and V<sub>6</sub> (64.33 days). On the other hand, minimum time was taken by V<sub>1</sub> (53.67 days) which was statistically similar with V<sub>2</sub> (54.33 days), V<sub>9</sub> (55.67 days), V<sub>3</sub> (56.67 days) and V<sub>5</sub> (57.67 days). Ullah *et al.* (2017b) found that minimum time needed for maize landraces to flowering was 53.66 days and maximum time was 65 days.

Days to harvesting was significantly influenced by the different maize landraces (Table 1). V<sub>8</sub> took highest time (128.67 days) which was statistically similar with V<sub>7</sub> (128 days) and V<sub>10</sub> (126 days). Here the lowest time was recorded by V<sub>1</sub> (105 days). Ullah *et al.* (2017b) recorded highest 129 days and lowest 106 days for different maize landraces harvesting in Bangladesh.

**Table 1. Number of leaves/plant, leaf length, leaf width, days to flowering and days to harvesting of local maize land races**

Variety	At tasseling			At harvesting			Days to flowering	Days to harvesting
	Number of leaves plant <sup>-1</sup>	Leaf length (cm)	Leaf width (cm)	Number of leaves plant <sup>-1</sup>	Leaf length (cm)	Leaf width (cm)		
V <sub>1</sub>	13.00 d	89.50 a	6.00 c	13.00 d	89.50 a	6.00 c	53.67 d	105.00 d
V <sub>2</sub>	13.67 cd	95.00 a	6.50 bc	13.67 cd	95.00 a	6.50 bc	54.33 d	108.33 cd
V <sub>3</sub>	17.67 a	67.50 c	6.50 bc	17.67 a	67.50 c	6.50 bc	56.67 d	111.33 cd
V <sub>4</sub>	15.67 a-c	77.50 b	7.50 ab	15.67 a-c	77.50 b	7.50 ab	61.00 bc	113.67 bc
V <sub>5</sub>	15.00 b-d	78.00 b	7.00 a-c	15.00 b-d	78.00 b	7.00 a-c	57.67 cd	118.00 b
V <sub>6</sub>	15.00 b-d	77.50 b	7.25 ab	15.00 b-d	77.50 b	7.25 ab	64.33 ab	114.00 bc
V <sub>7</sub>	16.67 ab	79.00 b	7.75 a	16.67 ab	79.00 b	7.75 a	61.67 bc	128.00 a
V <sub>8</sub>	18.00 a	91.50 a	7.65 ab	18.00 a	91.50 a	7.65 ab	66.67 a	128.67 a
V <sub>9</sub>	16.00 a-c	81.50 b	6.65 a-c	16.00 a-c	81.50 b	6.65 a-c	55.67 d	114.67 bc
V <sub>10</sub>	17.67 a	82.50 b	7.00 a-c	17.67 a	82.50 b	7.00 a-c	67.67 a	126.00 a
LSD <sub>(0.05)</sub>	2.44	5.96	1.20	2.44	5.96	1.20	4.22	6.34

V<sub>1</sub> = White, V<sub>2</sub> = Off white, V<sub>3</sub> = Purple, V<sub>4</sub> = Black, V<sub>5</sub> = Red, V<sub>6</sub> = Yellow, V<sub>7</sub> = Pink, V<sub>8</sub> = Yellow and Brown scattered, V<sub>9</sub> = Brown and V<sub>10</sub> = Variegated. Means followed by different letters in the same column differ significantly according to LSD test at 0.05 level of probability.

The stem base circumference was also different in maize landraces (Table 2). At flowering, the highest value was recorded in V<sub>10</sub> which was statistically similar with V<sub>8</sub> (7.85 cm) and V<sub>3</sub> (4.5 cm) showed the lowest circumference of stem base at numerical number. At harvesting stage, top value was found in V<sub>6</sub> (9.35 cm) and least value was found in V<sub>1</sub> (5.05 cm) (Table 1). Ullah *et al.*, (2017b) reported that stem base circumference of maize varieties ranges from 9.11 cm to 6 cm.

The root system length was the highest with V<sub>4</sub> and V<sub>8</sub> (around 24 cm) and the shortest root was found with V<sub>3</sub>. Root area circumference was found maximum in V<sub>9</sub> (25 cm). Minimum root area circumference was found in V<sub>7</sub> (14.5 cm) followed by V<sub>6</sub> (16.5) (Table 2).

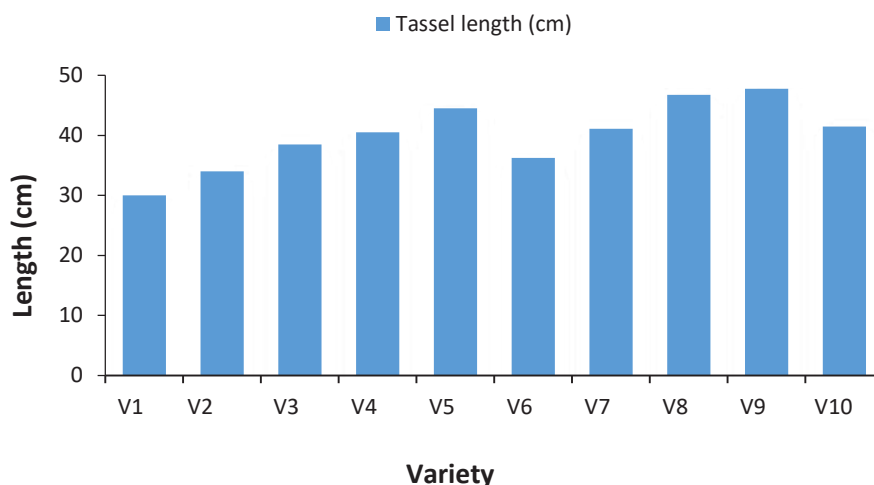
The numerical highest cob circumference (16.70 cm) was recorded in V<sub>4</sub> while numerical lowest cob circumference (10 cm) was recorded in V<sub>10</sub>. Ullah *et al.* (2017a) found that the landraces cob circumference ranged between 19.11 cm to 8.93 cm.

**Table 2. Stem base circumference, root length and root area circumference of maize landraces.**

Variety	Stem base circumference at flowering (cm)	Stem base circumference at harvesting (cm)	Root length (cm)	Root area circumference (cm)
V <sub>1</sub>	4.95 de	5.05 e	19.40 cd	22.50 b
V <sub>2</sub>	5.45 c-e	6.95 cd	19.90 cd	18.50 de
V <sub>3</sub>	4.50 e	6.20 d	17.50 d	17.00 e
V <sub>4</sub>	6.00 bc	7.15 c	23.50 ab	18.50 de
V <sub>5</sub>	5.80 b-d	6.80 cd	17.95 cd	18.50 de
V <sub>6</sub>	6.55 b	9.35 a	21.00 bc	16.50 ef
V <sub>7</sub>	6.75 b	7.00 cd	19.00 cd	14.50 f
V <sub>8</sub>	7.85 a	8.20 b	24.00 ab	20.00 cd
V <sub>9</sub>	6.00 bc	7.00 cd	20.00 cd	25.00 a
V <sub>10</sub>	8.40 a	8.45 b	24.50 a	21.50 bc
LSD <sub>(0.05)</sub>	1.04	0.83	3.07	2.47
CV (%)	9.71	6.68	8.65	7.49

V<sub>1</sub> = White, V<sub>2</sub> = Off white, V<sub>3</sub> = Purple, V<sub>4</sub> = Black, V<sub>5</sub> = Red, V<sub>6</sub> = Yellow, V<sub>7</sub> = Pink, V<sub>8</sub> = Yellow and Brown scattered, V<sub>9</sub> = Brown and V<sub>10</sub> = Variegated; Means followed by different letters in the same column differ significantly according to LSD test at 0.05 level of probability.

Maize landraces presented a significant difference in respect of the number of grains row-1 (Table 1). Among the varieties, V<sub>3</sub> had the maximum no. of rows cob-1 (16.17) and V<sub>6</sub> had the minimum no. of rows cob-1 (10.75) which was statistically similar with other two varieties V<sub>5</sub> and V<sub>2</sub>. This result was different from the study of Asghar *et al.* (2010) who found that the varieties did not differ significantly for number of rows cob-1. The highest tassel length (47.75 cm) was recorded in V<sub>9</sub> and lowest (30 cm) was recorded in V<sub>1</sub> (Fig. 2).



V<sub>1</sub> = White, V<sub>2</sub> = Off white, V<sub>3</sub> = Purple, V<sub>4</sub> = Black, V<sub>5</sub> = Red, V<sub>6</sub> = Yellow, V<sub>7</sub> = Pink, V<sub>8</sub> = Yellow and Brown scattered, V<sub>9</sub> = Brown and V<sub>10</sub> = Variegated

**Fig. 2.** Tassel length of maize landraces (LSD value = 3.06)

The maximum cob length was found in V<sub>1</sub>, while the minimum with V<sub>7</sub> (Table 3). The widest cob was with V<sub>4</sub>, while the thinnest was with V<sub>10</sub> over V<sub>2</sub>, which showed the cob length of about 27.25 cm. Minimum cob length (18.25 cm) was from V<sub>3</sub> (Table 3). The cob circumference was the widest with V<sub>4</sub>, which however was at par with those of V<sub>1</sub> and V<sub>2</sub>. Maize landraces showed significant difference in respect of the number of grains row-1 (Table 3). Among the varieties, V<sub>1</sub> exhibited the maximum

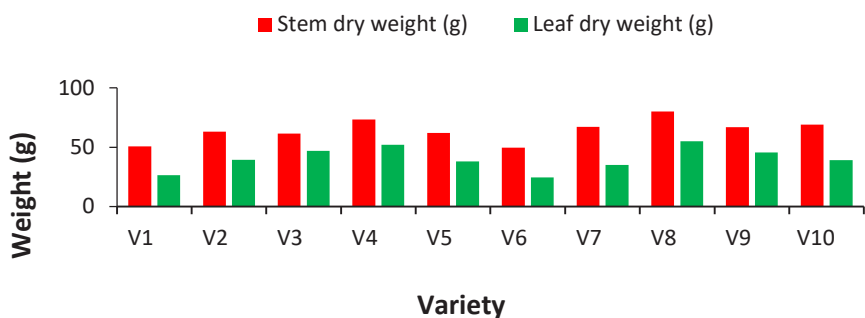
number of grains row<sup>-1</sup> (13.5), which was statistically similar with V<sub>7</sub> (25.5) and V<sub>9</sub> exhibited the minimum number of grains row<sup>-1</sup> (13), which was statistically similar with V<sub>2</sub> (14.33). Significant difference was found in different maize varieties in terms of total number of grains cob<sup>-1</sup> (Table 3). Highest number of grains was counted at V<sub>1</sub> (335.17). Lowest number of grains was counted at V<sub>9</sub> (164.31) which was statistically similar to V<sub>2</sub> (172.10).

**Table 3. Tassel length, cob length, cob circumference, rows cob<sup>-1</sup>, grains row<sup>-1</sup>, total no. of grains cob<sup>-1</sup> of local maize varieties.**

Variety	Cob length (cm)	Cob circumference (cm)	Grain rows cob <sup>-1</sup>	Grains row <sup>-1</sup>	Total number of grains cob <sup>-1</sup>
V <sub>1</sub>	28.40 a	14.95 a-c	12.70 bc	26.70 a	335.17 a
V <sub>2</sub>	27.25 a	15.60 ab	11.50 cd	14.33 f	172.10 f
V <sub>3</sub>	18.25 e	13.00 c-e	16.17 a	19.75 c	312.88 b
V <sub>4</sub>	24.25 b	16.70 a	12.25 bc	21.75 b	266.42 c
V <sub>5</sub>	23.35 bc	13.95 b-d	11.50 cd	18.13 de	215.83 de
V <sub>6</sub>	21.95 cd	12.70 de	10.75 d	18.00 de	200.50 e
V <sub>7</sub>	18.50 e	11.00 ef	12.17 bc	25.50 a	301.83 b
V <sub>8</sub>	21.55 cd	13.80 b-d	13.08 b	16.58 e	217.17 de
V <sub>9</sub>	23.00 b-d	13.05 c-e	12.17 bc	13.50 f	164.31 f
V <sub>10</sub>	21.00 d	10.00 f	12.33 bc	18.83 cd	231.67 d
LSD <sub>(0.05)</sub>	2.24	2.12	1.32	1.57	21.95
CV (%)	5.73	9.17	6.15	4.76	5.29

V<sub>1</sub> = White, V<sub>2</sub> = Off white, V<sub>3</sub> = Purple, V<sub>4</sub> = Black, V<sub>5</sub> = Red, V<sub>6</sub> = Yellow, V<sub>7</sub> = Pink, V<sub>8</sub> = Yellow and Brown scattered, V<sub>9</sub> = Brown and V<sub>10</sub> = Variegated; Means followed by different letters in the same column differ significantly according to LSD test at 0.05 level of probability.

It was exhibited that highest stem dry weight per plant was found in V<sub>8</sub>, (80 g) which was followed by V<sub>4</sub> (73.25 g) and V<sub>10</sub> (69 g). Lowest stem dry weight per plant was found in V<sub>6</sub> (49.75 g) which was followed by V<sub>1</sub> (50.80 g) (Fig. 3).



V<sub>1</sub> = White, V<sub>2</sub> = Off white, V<sub>3</sub> = Purple, V<sub>4</sub> = Black, V<sub>5</sub> = Red, V<sub>6</sub> = Yellow, V<sub>7</sub> = Pink, V<sub>8</sub> = Yellow and Brown scattered, V<sub>9</sub> = Brown and V<sub>10</sub> = Variegated

**Fig. 3.** Maize landraces stem dry weight and leaf dry weight (LSD value = 11.57 and 6.29 respectively).

From figure 3, it was also exhibited that highest leaf dry weight per plant was found in V<sub>8</sub> (55 g) which was followed by V<sub>4</sub> (52 g). Lowest leaf dry weight per plant was found in V<sub>6</sub> (24.5 g) which was followed by V<sub>1</sub> (26.40 g) (Fig. 3).

Different varieties had significant differences on total grain weight per plant. Total grain weight per plant ranges from 62.55 g to 27 g. Results represented in Table 4 indicated that the highest total grain

weight per plant was attained in V<sub>1</sub> (62.55 g) followed by V<sub>3</sub> (55.67 g) whereas, the lowest was in V<sub>6</sub> (27 g) followed by V<sub>5</sub> (31.13 g).

A statistically significant difference between landraces was found regarding the 100 grains weight. Table 4 shows the effect of local varieties on 100 grains weight. Among the varieties, the maximum 100 grains weight (23.36 g) was found from V<sub>1</sub>. V<sub>6</sub> showed the minimum 100 grains weight (14.94 g). Local maize landraces showed a significant difference in respect of chaff weight per cob Table 4). Among the landraces, V<sub>6</sub> showed the maximum chaff weight (10.88 g) and V<sub>10</sub> showed the minimum chaff weight (4.75 g) which was statistically similar with V<sub>8</sub> (4.88 g). Ullah *et al.* (2017a) observed that chaff weight of landraces ranges 8.64 to 4.34 cm which is similar to this study.

Significant variation was recorded in case of shell weight for different maize landraces (Table 4). The shell weight ranges from 17.13 g to 9.75 g due to different maize landraces. The highest shell weight (17.13 g) was recorded from V<sub>4</sub>. On the other hand, the lowest shell weight (9.75 g) was recorded from V<sub>9</sub>.

Maize landraces performed significant difference in respect of grain yield (Table 4). Among the varieties, V<sub>1</sub> showed the highest grain yield (3.10 t ha<sup>-1</sup>). On the other hand, V<sub>6</sub> showed the lowest grain yield (1.28 t ha<sup>-1</sup>) which was statistically similar with V<sub>5</sub> (1.30 t ha<sup>-1</sup>).

The effect of landrace varieties on stover yield is displayed in Table 4. In case of stover yield, a significant difference between varieties was found. V<sub>8</sub> showed the highest stover yield (6.89 t ha<sup>-1</sup>) which was statistically similar with V<sub>4</sub> (6.71 t ha<sup>-1</sup>) and V<sub>6</sub> showed the lowest stover yield (4.40 t ha<sup>-1</sup>) which was statistically similar with V<sub>1</sub> (4.52 t ha<sup>-1</sup>).

Significant difference in respect of biological yield was observed in maize landraces (Table 4). Among the varieties, V<sub>4</sub> exhibited the highest biological yield (8.92 t ha<sup>-1</sup>) which was statistically similar with V<sub>8</sub> (8.76 t ha<sup>-1</sup>) and V<sub>3</sub> (8.32 t ha<sup>-1</sup>). On the other hand, V<sub>6</sub> showed the lowest biological yield (5.68 t ha<sup>-1</sup>). Asghar *et al.* (2010) found the different findings as the varieties did not show any difference in producing biological yield.

**Table 4. Grain yield, stover yield, biological yield and harvest index of different maize landraces.**

Variety	Total grains weight plant <sup>-1</sup> (g)	100 grains weight (g)	Chaff weight cob <sup>-1</sup> (g)	Shell weight cob <sup>-1</sup> (g)	Grain yield (t ha <sup>-1</sup> )	Stover yield (t ha <sup>-1</sup> )	Biological yield (t ha <sup>-1</sup> )	Harvest index (%)
V <sub>1</sub>	62.55 a	23.36 a	9.30 bc	15.90 ab	3.10 a	4.52 c	7.62 bc	40.72 a
V <sub>2</sub>	40.17 ef	22.02 ab	8.78 c	15.71 a-c	1.97 d	5.61 b	7.58 bc	25.96 c
V <sub>3</sub>	55.67 b	21.84 ab	6.25 e	14.88 bc	2.60 b	5.72 b	8.32 ab	31.30 b
V <sub>4</sub>	50.13 c	18.90 cd	9.75 b	17.13 a	2.21 c	6.71 a	8.92 a	24.97 c
V <sub>5</sub>	31.13 gh	15.44 e	9.94 b	13.63 cd	1.30 f	5.46 b	6.76 d	19.28 e
V <sub>6</sub>	27.00 h	14.94 e	10.88 a	14.63 b-d	1.28 f	4.40 c	5.68 e	22.46 d
V <sub>7</sub>	45.50 cd	17.65 d	7.08 d	15.00 a-c	1.82 d	5.48 b	7.30 cd	25.06 c
V <sub>8</sub>	42.46 de	19.48 cd	4.88 f	16.29 ab	1.87 d	6.89 a	8.76 a	21.33 de
V <sub>9</sub>	35.75 fg	18.35 d	6.08 e	9.75 e	1.60 e	5.66 b	7.26 cd	22.03 d
V <sub>10</sub>	47.58 c	20.52 bc	4.75 f	12.67 d	2.00 d	5.53 b	7.53 cd	26.57 c
LSD <sub>(0.05)</sub>	4.75	2.11	0.76	2.14	0.20	0.67	0.78	2.22
CV (%)	6.32	6.40	5.71	8.58	5.94	6.99	5.97	4.99

V<sub>1</sub> = White, V<sub>2</sub> = Off white, V<sub>3</sub> = Purple, V<sub>4</sub>= Black, V<sub>5</sub>= Red, V<sub>6</sub>= Yellow, V<sub>7</sub>= Pink, V<sub>8</sub>= Yellow and Brown scattered, V<sub>9</sub>= Brown and V<sub>10</sub>= Variegated; Means followed by different letters in the same column differ significantly according to LSD test at 0.05 level of probability.

Maize landraces harvest index differences are shown in Table 4. The conducted experiment revealed that there was significant statistical difference between local varieties regarding harvest index. V<sub>1</sub> showed the maximum harvest index (40.72%). On the other hand, V<sub>5</sub> showed the minimum harvest index (19.28%) which was statistically similar with V<sub>8</sub> (21.33%). Based on the experimental results, it

may be concluded that White kernel landrace performed better yield than others. In case of stover production, yellow and brown scattered kernel landrace is higher than the other landraces. It can be used as silage producing genotype in kharif season.

**Acknowledgement:** Authors acknowledge the financial support of Sher-e-Bangla Agricultural University Research System (SAURES) to conduct this study.

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