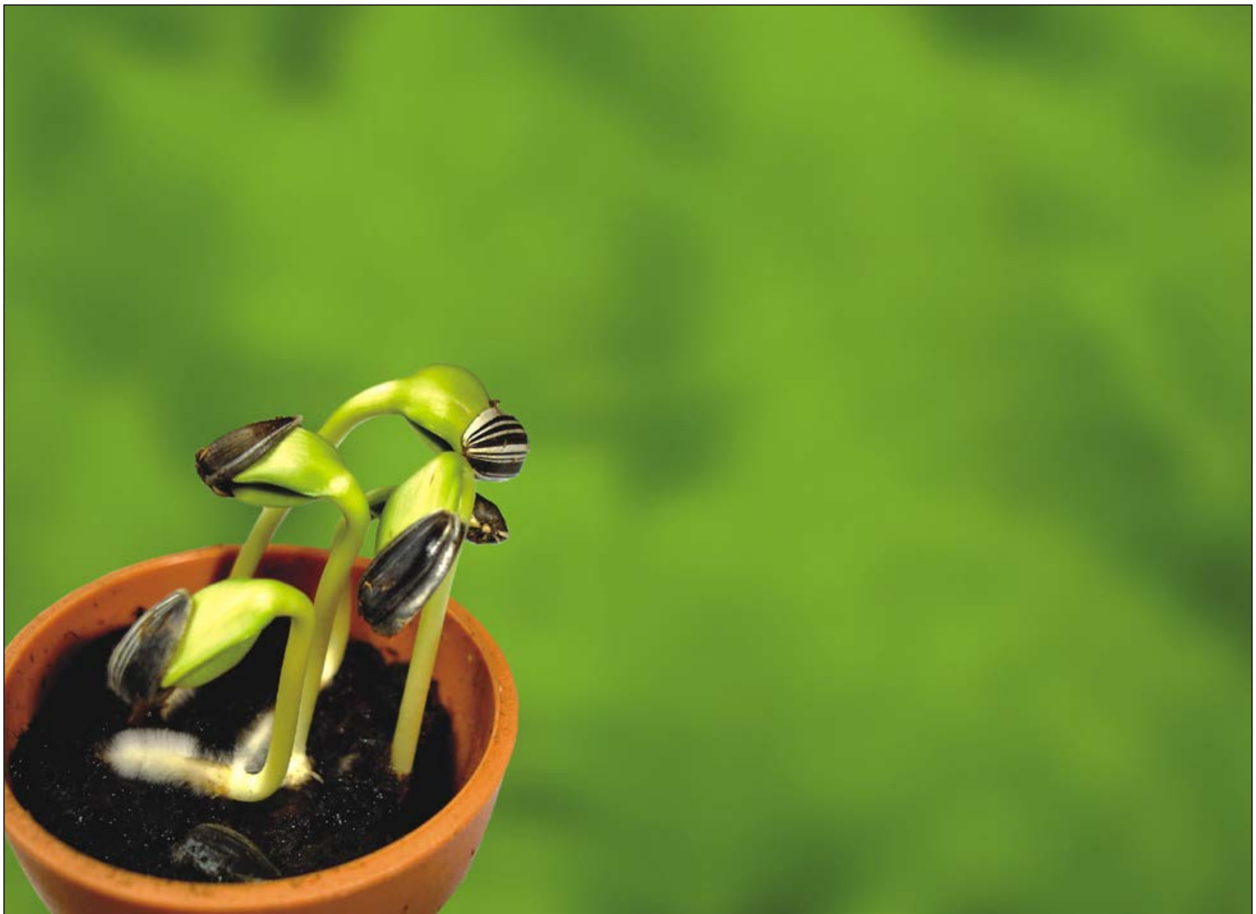

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Research Article
Morphological Features and Yield Evaluation of Onion (*Allium cepa* L.) Genotypes in Acid Soil

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Abstract
Background and Objective: An experiment was conducted to study the morphological and yield characters with 5 genotypes of onion viz., Big Bombay, Special Bombay, Choto Bombay (control), Uz-1 and Uz-2 at the study farm of Sylhet Agricultural University, Sylhet, Bangladesh from November, 2013 to July, 2014 with a view to select the suitable genotypes based on higher yielding abilities in acidic soil condition. **Materials and Methods:** The experiment was laid out in a Randomized Complete Block Design (RCBD) with 3 replications. **Results:** Results revealed that the genotype Uz-2 were produced the highest bulb yield (5.85 t ha^{-1}) followed by Special Bombay onion (4.87 t ha^{-1}) and Uz-1 (3.92 t ha^{-1}), while the lowest was found in Choto Bombay onion constituted the amount only 2.21 t ha^{-1}. These high yields were obtained due the highest yield contributing characteristics present among the onion genotypes. The genotype Uz-2 also produced the highest yield contributing characteristics like bulb fresh weight (45.56 g), leaf sheath diameter (1.55 cm) and bulb diameter (4.80 cm) while Special Bombay onion produced the highest bulb length (5.32 cm), bulb dry weight (9.2 g), leaf sheath length (5.1 cm), leaf sheath dry weight (1.9 g) and leaf blade dry weight (2.24 g). Similarly, the genotype Uz-1 produced the third highest bulb yield but obtained the maximum leaf blade diameter (1.17 cm), leaf blade length (85 cm) and fresh weight of leaf blade (53.25 g). The study finding will help for further study in onion crop to find out the genotypic effect which is suitable for acidic soil environment. **Conclusion:** Considering yield and yield contributing characters, the genotype Uz-2 can be selected as the best genotype for growing in acidic soil at Sylhet region of Bangladesh. Therefore, the findings of the present study will help the breeders for further yield improvement of onion in acid soil.

Key words: Genotypes, acidic soil, morphology, characters, yield, onion, evaluation, growth

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Onion (*Allium cepa* L.) is widely grown vegetable crop belongs to the family Alliaceae used for daily human consumption in almost all the countries in the world. It is one of the most important vegetables crops and used both the green and mature bulb stages as a salad, vegetable and spices[1]. Moreover, it is the second important horticultural crop after tomatoes[2] and one of the most important vegetable crops whose leafy portion as a vegetable and bulbs as salad and spice are used daily[3]. It has a great demand due to its flavour, pungent taste, medicinal value and low price containing rich carbohydrates, protein, vitamin A, thiamine, riboflavin, niacin and ascorbic acid[4]. Onion being important vegetable crop needs proper attention for producing better quality seeds and bulbs. The lower yields are attributed to limited availability of good quality seeds and improved varieties. Improved seed varieties would contribute to crop yield[5] up to 30%. Onion yield could be regarded as a complex character, which is dependent on a number of agronomic characters especially bulb and leaf quality[6]. In some cases onion production influenced by many factors like pathogens which reduces the bulb quality[7], insect infestation hamper the yield[8] and could be genetic or environmental[9,10].

Acid soil is the tremendous problem for the crop production in the world. In acidic soil, toxicity is created mainly by lack of essential nutrients in the soil and also excessive toxic metals in the plant root zone. Plant species have evolved to variable levels of tolerance to acidity enabling breeding of high acid tolerant cultivars. Physiological and molecular approaches have revealed some mechanisms of acid toxicity in higher plants[10]. The production and research on onion cultivation in acidic soil conditions in Sylhet region is almost nill. High and medium lands of the region contain acid soils with pH ranging from 4.8-5.7 with high content of iron. The cultivation of onion is unknown to the farmers in this region due to the lack of local variety. The yield performance of any crops depends on some physiological characteristics[11].

In Bangladesh, the demands for onion are augmenting day by day, where the area under onion cultivation is not increasing rather it is reducing. As a result, Bangladesh has to import onion from other countries to meet its demand. Lack of using modern genotypes and optimum fertilizer dose may be a major constraint of maximum harvest[12]. Onion is a shallow rooted crop, a fairly high concentration of nutrient should normally be maintained at the surface of the soil for its optimum growth and yield. Onion genotypes vary in their nature of bulbing with wide range of production of yield parameters and yield. Hence, immediate attention needs to be given to improve the productivity of onion. The knowledge about interrelationship among bulb yield and its components and their relative contribution towards the bulb yield is important for a fruitful selection. In the present study an attempt was undertaken to observe the suitable genotypes having better growth and morphological characteristics on acidic soil condition in Sylhet region of Bangladesh.

MATERIALS AND METHODS

Soil and climate: The experiment was carried out at the experimental field of the Department of Crop Botany and Tea Production Technology, Sylhet Agricultural University, Sylhet, Bangladesh during November, 2013 to April, 2014 to evaluate the morphological attributes and yield performance of 5 genotypes of onion in acidic soil. The climate and soil of the selected plot was under subtropical climate having heavy rainfall during April-September (Kharif season) and scanty rainfall during October-March (Rabi season), high land type, well drained and non-calcareous grey flood plain fertile soils of acidic nature. The soil pH, nutrient status of the soil, monthly air temperature, relative humidity, rainfall and sunshine hours are presented in the Table 1 and 2.

Experimental materials and design: Five genotypes of onion were used as experimental materials. Among them 3 genotypes namely Choto Bombay onion, Special Bombay

Table 1: Nutrient status of the soil of experimental field

Elements	Amount
Soil pH	4.83
Organic matter (%)	1.39
Potassium (mili equivalent/100 g of soil)	0.38
Nitrogen (%N)	0.07
Phosphorus (µg g^{-1} of soil)	9.15
Sulphur (µg g^{-1} of soil)	37.98

Regional Office of SRDI (Soil Resources Development Institute), Sylhet 3100, Bangladesh

Table 2: Monthly air temperature (°C), relative humidity, rainfall and sunshine hours per day of the experimental site during the period from November, 2013 to April, 2014

	Monthly average air temperature (°C)				
Months	Maximum average	Minimum average	Average rainfall (mm)	Average relative humidity (%)	Average daily sunshine (h)
November	28.7	16.5	13	69	3.8
December	25.9	14.3	0.0	76	4.3
January	24.6	13.2	0.0	66	4.4
February	22.4	12.9	0.0	61	4.1
March	24.3	15.2	10	57	4.8
April	36.2	17.0	16	59	5.6

Sylhet Meteorological Station, Sylhet 3100, Bangladesh onion and Big Bombay onion were collected from Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh and rest two genotypes viz., Uzbekistan-1 and Uzbekistan-2 were collected from Uzbekistan. The genotype Choto Bombay onion was used as a control variety. The experiment was laid out in a Randomized Complete Bock Design (RCBD) with 3 replications. The size of experimental plot was 3.4×0.7 m. Planting distance between the rows were 15 cm and plants were 12 cm. Seeds were randomly spread out on the seedbed on 11 November, 2013. Then the seeds were covered with soil by hand. Seedling of onion genotypes were transplanted from seedbed to the experimental field on 10 December, 2013. The plot were fertilized with a general dose of urea, Triple Super Phosphate (TSP), muriate of potash (MOP) as sources of nitrogen, phosphorus and potassium were applied at 110, 130 and 80 kg ha^{-1}, respectively.

Data collection and analysis: Final harvesting of the crop was done on 28 April, 2014 when they attained edible stage. Morphological and yield attributes parameters viz., leaf sheath length (cm), leaf sheath diameter (cm), leaf blade length (cm), leaf blade diameter (cm), bulb length (cm), bulb diameter (cm) were recorded with sampling of 8 plants per plot starting from 70 Days after Planting (DAS) to the final harvest with 15 days interval. After sampling the plant, the plant parts were separated into leaves, bulbs and roots and recorded the corresponding fresh weight and dry weight in micro-oven at 80±2°C for 72 h and calculated the morphological growth parameters like leaf sheath fresh weight per plant (g), leaf sheath dry weight per plant (g), leaf blade fresh weight per plant (g), leaf blade dry weight per plant (g), bulb fresh weight per plant (g), bulb dry weight per plant (g), root fresh weight per plant (g), root dry weight per plant (g). Yields were calculated in kilogram per hectare for all genotypes. The collected data were analyzed statistically and the mean differences were separated with Duncan's Multiple Range Test (DMRT) at 5% level of significance using the statistical computer package program, MSTATC[13].

RESULTS AND DISCUSSION

Morphological characters

Leaf sheath length (cm): Leaf sheath length varied significantly among the genotypes studied (Fig. 1). The leaf sheath length was increased with the increasing time. At final harvest, the highest leaf sheath length (5.1 cm) was found in Special Bombay onion followed by Choto Bombay onion (4.9 cm), Uz-1 (4.8 cm) while the lowest was found in

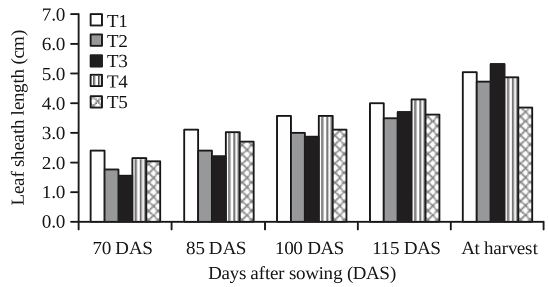

Fig. 1: Leaf sheath length at different DAS for different genotypes of onion, T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2

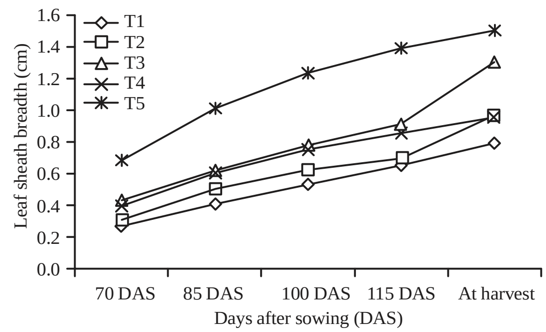

Fig. 2: A linear graph of leaf sheath breadth of onion genotypes at different DAS, T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4, Uzbekistan-1, T5: Uzbekistan-2

Uz-2 (3.5 cm). Similarly, the maximum leaf sheath length (4.10 cm) was noted in Uz-1 genotype which was closely followed by Choto Bombay onion (4.0 cm) at 115 DAS. Leaf sheath length is one of the selection criteria for acid tolerance onion lines. The onion varieties were significantly different when it comes to the plant and bulb morphological characteristics[14]. Similar results of variability were found by Attri *et al.*[15] in cv Shah Bannu local and Tank local.

Leaf sheath diameter (cm): Cumulative leaf sheath diameter was followed a linear curve during the growing season (Fig. 2). The genotype Uz-2 was produced the maximum leaf sheath diameter (1.55 cm) and Choto Bombay onion genotype yielded the lowest leaf sheath diameter (0.79 cm). Similar result was found in Big Bombay onion and Uz-1 (0.95 cm). Ashok *et al.*[16] showed that all the varieties/lines (Sel 383, Sel 126, Sel 402, N-53, Pusa madhbi and Pusa white) showed significant differences for the characters studied. Normally, a leaf ratio below unity is coincident with marked swelling of the

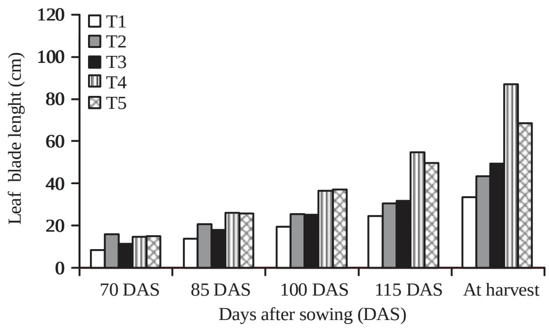

Fig. 3: Leaf blade length (cm) at different DAS for different genotypes of onion, T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2

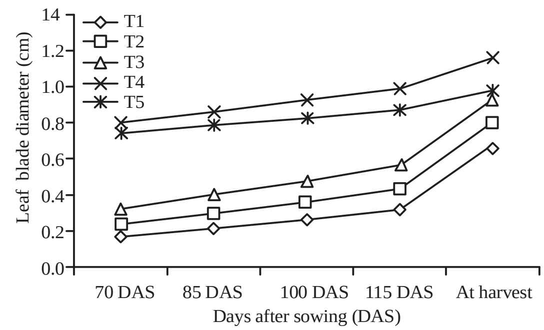

Fig. 4: Leaf blade diameter (cm) of different onion genotypes represented by linear graph at different DAS, T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2

outer leaf sheaths and a consequent rapid increase in 'Bulbing ratio' that means minimum sheath diameter resulting maximum bulb diameter[17].

Leaf blade length (cm): Significant variations on leaf blade length were found among the different genotypes (Fig. 3). Leaf blade length also increased in all the genotypes with the advancement of growth. At 115 DAS and harvest stage, the maximum leaf blade length (48 and 85 cm, respectively) was found in genotype Uz-1 followed by Uz-2 (49 and 67.94 cm, respectively). The length of bulb increased continuously with increased time till maturity and the highest was found in genotype Uz-1. Attri *et al.*[15] observed that the longest length leaves (55.8 cm) were obtained in cv Shah Alam followed by Swat-I and the shortest leaves of 36.20 cm was noted in Bannu local and Tank local.

Leaf blade diameter (cm): Leaf blade diameter is important to maximize crop growth and yield. Leaf blade diameter was varied at different DAS among the genotypes (Fig. 4). Cumulative leaf blade diameter was followed a curve during the growing season. The genotype Uz-1 was obtained the maximum leaf blade diameter which constituted 1.17 cm and the minimum was recorded in Choto Bombay onion genotype of 0.68 cm at final stage. Dwivedi *et al.*[18] observed the difference in production of leaves and leaf weight between varieties of onion and attributed this difference mainly to the cultivar, but other researchers confirmed that environmental conditions[19] in which plant grown contribute to the development of leaves on plant.

Bulb length (cm): Bulb length is a measure of healthy growth. At 115 DAS and final harvest, the bulb length was the highest in Special Bombay onion (3.12 and 5.32 cm, respectively) and the smallest was noted in Choto Bombay onion (2.38 and 3.74 cm, respectively) among all genotypes (Table 3). Bulb length was increased due to the age of the onion plant. It is clearly indicated that bulb length increased for its genetic characters present in the genotype. Ashok *et al.*[16] recorded the maximum bulb length from early grano and the minimum from Sel 383. The length of the onion bulb is dependent upon the number and size of the green leaves or tops at the time of bulb maturity.

Table 3: Bulb length (cm) of different onion genotypes at different DAS

	Bulb length (cm)				
Genotypes	70 DAS	85 DAS	100 DAS	115 DAS	At harvest
T1	0.933^{c}	1.390^{b}	1.843^{b}	2.380^{b}	3.743^{c}
T2	1.723^{a}	2.167^{a}	2.613^{a}	2.933^{ab}	5.067^{ab}
T3	1.433^{ab}	1.923^{ab}	2.510^{ab}	3.120^{a}	5.323^{a}
T4	1.210^{bc}	1.657^{ab}	2.200^{ab}	2.767^{ab}	4.533^{b}
T5	0.947^{c}	1.390^{b}	1.900^{ab}	2.483^{ab}	5.170^{a}
CV (%)	14.31	12.19	11.05	14.83	8.27

T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2, DAS: Days after sowing. In a column, figure bearing same letter(s) do not differ significantly at 5% level by DMRT

Bulb diameter (cm): Significant variations on bulb diameter were found among the different genotypes of onion (Fig. 5). Bulb diameter increased in all the genotypes with the advancement of growth. The rate of increase in bulb diameter was rapidly increased from 70-115 DAS and then the highest bulb diameter was attained at final harvest for all the genotypes. Results revealed that Uz-2 had the highest than the other genotypes at final stage which was about 4.81 cm and Choto Bombay onion produced the narrowest bulb diameter (3.22 cm). For each leaf there will be a ring of onion formed, the larger the leaf, the larger the diameter of bulb[11].

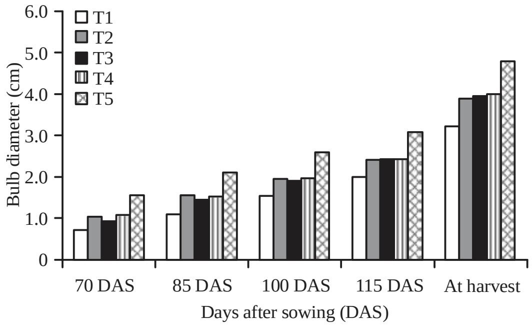

Fig. 5: Bulb diameter at different DAS for different genotypes of onion, T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2

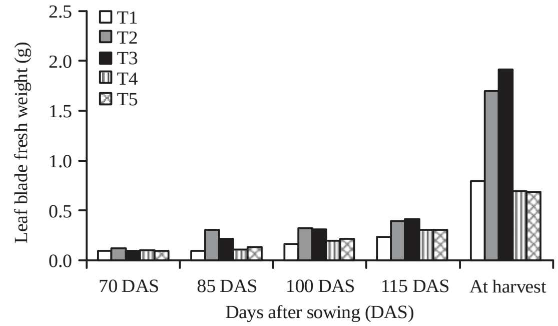

Fig. 6: Leaf sheath dry weight (g) at different DAS for different genotypes of onion, T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2

Table 4: Leaf sheath fresh weight (g) of different onion genotypes at different DAS

	Leaf sheath fresh weight (g)				
Genotypes	70 DAS	85 DAS	100 DAS	115 DAS	At harvest
T1	0.657[b]	1.663[a]	3.057	4.467[ab]	8.200[b]
T2	0.753[b]	1.900[ab]	3.367	5.390[a]	10.810[a]
T3	0.863[b]	2.110[ab]	3.587	5.143[a]	10.787[a]
T4	1.853[a]	2.323[ab]	2.807	3.207[b]	4.447[c]
T5	1.657[a]	2.723[a]	3.810	4.653[a]	5.990[c]
$lsd_{0.05}$	0.616	0.9108	1.197	1.389	1.927
CV (%)	8.32	6.57	9.11	6.13	10.71

T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2, DAS: Days after sowing. In a column, figure bearing same letter(s) do not differ significantly at 5% level by DMRT

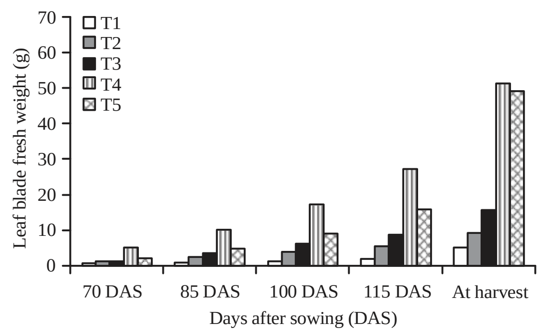

Fig. 7: Leaf blade fresh weight (g) at different DAS for different genotypes of onion, T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2

Growth parameters

Leaf sheath fresh weight per plant (g): Significant variations on leaf sheath fresh weight were found among different genotypes (Table 4). Leaf sheath fresh weight increased in all the genotypes with the advancement of growth. Results revealed that leaf sheath fresh weight was the highest (10.81 g) in Big Bombay Onion with all the stages among the genotypes, which were closely followed by Special Bombay onion (10.787 g) whereas, the lowest was found in Uz-1 (4.447 g). Similarly, at 115 DAS, Big Bombay onion produced the highest leaf sheath fresh weight (5.39 g) than the other genotypes while the lowest was produced by Uzb-1 (3.21 g). Mahanthesh *et al.*[1] had found similar result on different variety.

Leaf sheath dry weight per plant (g): Genotypes had the significant difference in leaf sheath dry weight (Fig. 6). At final harvest stage, the highest leaf sheath dry weight (1.9 g) was found in Special Bombay onion followed by Big Bombay onion (1.6 g) whereas, the smallest leaf sheath dry weight (0.69 g) was found in Uz-2 (0.70 g). Moreover, the highest leaf sheath dry weight (0.42 g) was noted in Special Bombay onion, which was closely followed by Big Bombay onion (0.41 g) at 115 DAS. Leaf sheath dry weight was increased due to the growth characters of the genotypes. Ibrahim[20] showed similar variation on different varieties of onion.

Leaf blade fresh weight per plant (g): Leaf blade fresh weight varied significantly among the genotypes studied (Fig. 7). The highest leaf blade fresh weight (53.25, 31.8, 18.5 , 11.67 and 5.45 g) was observed in Uz-1 (at harvest, 115, 100, 85 and 70 DAS, respectively). This result was similar with the genotype Uz-2 whereas, Choto Bombay, Big Bombay and Special Bombay were less increasing respective to Uz-1. At harvest, leaf blade fresh weight (5.4, 9.12 and 10.4 g, respectively) was found in the genotypes Choto Bombay, Big Bombay and Special Bombay while the genotype Choto Bombay were produced the lowest 1. Higher photosynthates accumulation in the leaves would ensure higher individual leaf blade fresh weight[21].

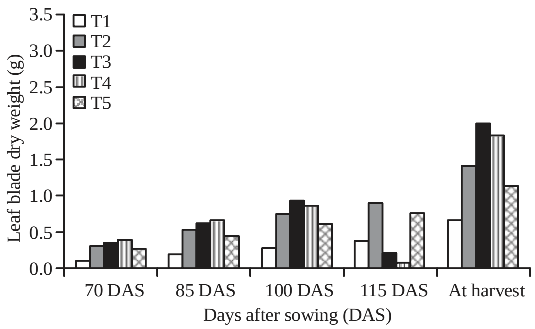

Fig. 8: Leaf blade dry weight (g) at different DAS for different genotypes of onion, T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5, Uzbekistan-2

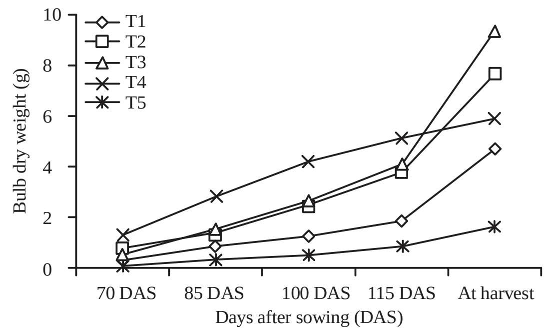

Fig. 9: Bulb dry weight (g) of different onion genotypes represented by linear graph at different DAS, T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2

Table 5: Bulb fresh weight (g) of different onion genotypes at different DAS

	Bulb fresh weight (g)				
Genotypes	70 DAS	85 DAS	100 DAS	115 DAS	At harvest
T1	1.180^{b}	3.153^{b}	6.083^{b}	9.903^{b}	18.827^{b}
T2	2.050^{b}	4.733^{ab}	8.747^{ab}	12.187^{ab}	26.087^{ab}
T3	1.700^{b}	4.613^{b}	7.567^{ab}	10.597^{b}	37.490^{ab}
T4	5.710^{a}	10.577^{a}	16.023^{a}	21.500^{a}	36.733^{ab}
T5	3.720^{ab}	7.463^{ab}	11.757^{ab}	17.567^{ab}	45.563^{a}
CV (%)	11.24	7.73	8.42	10.56	7.10

T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2, DAS: Days after sowing. In a column, figure bearing same letter(s) do not differ significantly at 5% level by DMRT

Leaf blade dry weight per plant (g): Leaf blade dry weight varied significantly among the genotypes studied (Fig. 8). At the harvesting stage, Special Bombay onion produced the highest leaf blade dry weight (2.24 g) closely followed by Uz-1 (2.11 g) while Choto Bombay onion produced the lowest dry weight (0.61 g). Similarly, at 100 DAS, the highest leaf blade dry weight (0.90 g) was noted in Special Bombay onion which was followed by Uz-1 (0.80 g) and Big Bombay onion (0.6 g). The result showed that Uz-1 genotype fluctuates more than other genotypes from 70 DAS to harvest whereas Big Bombay onion genotype gradually increased with the age. Ashok *et al.*[16] showed that Pusa Madhbi had the highest leaf blade dry weight and early grano obtained the lowest.

Bulb fresh weight per plant (g): The fresh weight of bulb also varied significantly among the genotypes (Table 5). Bulb fresh weight increased in all the genotypes with the advancement of growth. At 70 DAS, bulb fresh weight was found the highest (5.71 g) in genotype Uz-1 while at 85, 100 and 115 DAS (10.58, 16.02 and 21.50 g, respectively). The Uz-1 had also the highest bulb weight among the genotypes. On the other hand at 70, 85, 100 and 115 DAS the genotype Choto Bombay onion produced the lowest bulb fresh weight (1.18, 3.15, 6.08 and 9.90 g, respectively). Results showed that Uz-2 had highest bulb fresh weight (45.56 g) while, Choto Bombay had lowest at harvest than other genotypes. Average bulb fresh weight declined when harvest was delayed 30 days if bulbs were uprooted, but did not decline significantly if bulbs remained rooted after maturity[22].

Bulb dry weight per plant (g): Bulb dry weight is important to maximize crop yield varied with different growth stage among the genotypes (Fig. 9). Cumulative bulb dry weight was followed a linear curve at different stages of growth. The maximum bulb dry weight was (0.2-9.2 g) found in genotype Special Bombay onion than the other genotypes and the minimum fluctuation also found which was similar to Big Bombay (0.7-7.9 g, respectively). Minimum bulb dry weight (0.1-1.4 g) had in the genotype Uz-2 than other genotypes. The increased total soluble solids were due to enhanced physiological activity and availability of nutrients and development of strong source and sink relationship. Dewangan and Sahu[23] also found the similar results. According to Singh *et al.*[22], percent dry weight of bulb can increase because of bulb desiccation or solids accumulation and can decrease because of respiration or higher bulb hydration.

Root fresh weight per plant (g): Like the leaf sheath fresh weight of each plant, the fresh weight of root also varied significantly among the genotypes (Table 6). Root fresh weight increased in all the genotypes with the advancement of growth. At 85, 100 and 115 DAS (0.58, 0.76 and 0.91 g, respectively) Uz-1 had the highest root fresh weight among the genotypes whereas Big Bombay onion produced the lowest root fresh weight (0.18, 0.30 and 0.40 g, respectively).

Table 6: Root fresh weight (g) of different onion genotypes at different DAS

	Root fresh weight (g)				
Genotypes	70 DAS	85 DAS	100 DAS	115 DAS	At harvest
T1	0.067[c]	0.240	0.433	0.683	1.123
T2	0.073[c]	0.183	0.297	0.403	0.787
T3	0.090[bc]	0.207	0.337	0.463	1.323
T4	0.420[a]	0.580	0.760	0.907	1.773
T5	0.340[ab]	0.570	0.693	0.840	1.493
CV (%)	11.61	13.23	10.77	8.20	9.52

T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2. DAS: Days after sowing. In a column, figure bearing same letter(s) do not differ significantly at 5% level by DMRT

Table 7: Root dry weight (g) of different onion genotypes at different DAS

	Root dry weight (g)				
Genotypes	70 DAS	85 DAS	100 DAS	115 DAS	At harvest
T1	0.047	0.087	0.140[ab]	0.200[bc]	0.360[b]
T2	0.057	0.123	0.193[a]	0.330[a]	0.463[a]
T3	0.070	0.130	0.190[a]	0.257[ab]	0.423[a]
T4	0.033	0.073	0.120[b]	0.167[c]	0.330[b]
T5	0.040	0.077	0.117[b]	0.163[c]	0.363[b]
CV (%)	10.61	8.37	7.78	6.90	8.70

T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2. DAS: Days after sowing. In a column, figure bearing same letter(s) do not differ significantly at 5% level by DMRT

Finally at harvest, Uz-1 had the highest root fresh weight (1.77 g) and Big Bombay onion gave the lowest root fresh weight (0.79 g). Ibrahim[20] recorded similar variation on different varieties.

Root dry weight per plant (g): The result showed that the root dry weight increased with the age of plant and the maximum was found at 115 DAS (Table 7). The maximum root dry weight was found at different genotypes at different DAS as special Bombay onion Special Bombay (0.07 g) at 70 DAS and (0.13 g) at 85 DAS, Big Bombay onion and special Bombay onion Uz-1 are similar (0.19 g) at 100 DAS and Big Bombay onion (0.46 g) at 115 DAS, respectively. On the other hand, in most of the cases minimum root dry weight was found in the genotype Uz-1 except 115 DAS whereas only Uz-2 showed the minimum root dry weight (0.16 g). Dry matter production of a crop is dependent on the size of the photosynthetic system and the length of growth period, during which photosynthesis continues[20,24].

Bulb yield (t ha^{-1}): The data on yield of five onion genotypes was measured and presented in the Fig. 10. Yield (t ha^{-1}) of onion genotypes had statistically significant ($p \leq 0.05$) variation at final harvest. The Uz-2 showed the highest yield (5.85 t ha^{-1}) followed by Special Bombay onion (4.87 t ha^{-1}) and Uz-1 (3.92 t ha^{-1}) while the lowest was found in Choto Bombay onion constituted the amount only 2.21 t ha^{-1}. The increase in yield could also be due to length of leaf, number of leaves per plant, seed yield per plant, length and diameter of bulb, fresh and dry weight of bulb were positively influenced the yield of onion. These results were corroborated with the findings of Ali *et al.*[25]. Similarly, Attri *et al.*[15] observed that the number of leaves formed before bulbing was positively and significantly correlated with bulb yield. The yield attributes and quality of onion was found to be gradually increased with the increase in bulb size[11,26,27].

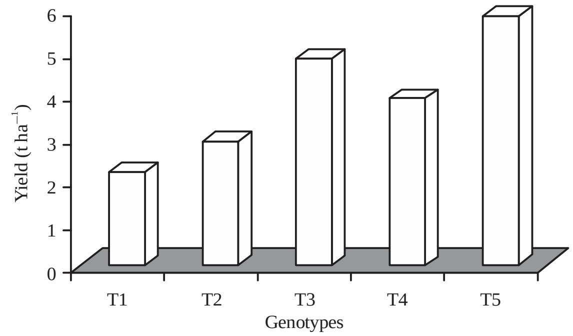

Fig. 10: Bulb yield (t ha^{-1}) for different genotypes of onion, T1: Choto Bombay onion, T2: Big Bombay onion, T3: Special Bombay onion, T4: Uzbekistan-1, T5: Uzbekistan-2

CONCLUSION

It can be concluded that the onion genotypes can be easily differentiated from one another due to their distinctive morphological characters and their yield performance under acid soil conditions in Sylhet region of Bangladesh. The genotype Uz-2 showed the highest performance among the genotypes and selected as the best genotype for acid soil conditions due to its yield and yield contributing characters. The present study, results will little bit help for further research in onion crop, where genotypic effects will be measured in acid soil environment. Further investigation should be needed in different agro-ecological climates of Bangladesh in order to confirm the present findings.

SIGNIFICANCE STATEMENTS

Each plant has the capacity to grow up with their inheritance traits and its present environments. In this study, we were tried to find out the capacity of an onion plant to grow in acidic soil condition and also find out the genetic reasons for adaptation. Thousands and thousands hectare of land remain as fellow due to the acidic soil condition in Bangladesh. But there are no existing onion varieties available those are tolerance to acidic soil condition. For these reason, acid tolerance variety development is mandatory to incur these land as cultivated area for more production to fulfill the food demand of the over populated country. There are more varieties are available in Bangladesh for the production of onion but we find out few varieties those are genetically performed the tolerance in the acid soil. Advance study will be needed to develop onion variety suitable for acidic soil.

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