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Storability study of different short-day onion (*Allium cepa* L.) genotypes/varieties

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Abstract
A total of 25 short-day onion genotypes along with two recommended varieties *viz*. BARI Piaz-1 and BARI Piaz-4 were evaluated for 5 and ½ months at the bamboo-made ambient storage. The study was conducted at Spices Research Sub-Centre, Bangladesh Agricultural Research Institute, Faridpur, Bangladesh in 2020 with the geographic coordinates- 23° 11' N and 89° 09' E. for assessing their storability. All genotypes in the trial were evaluated under 25 accession lines such as AC Bog 409, AC Bog 410, AC Bog 411, AC Bog 412, AC Bog 413, AC Bog 414, AC Bog 415, AC Bog 416, AC Bog 417, AC Bog 419, AC Bog 420, AC Bog 421, AC Bog 422, AC Bog 423, AC Bog 424, AC Bog 425, AC Bog 426, AC Bog 427, AC Bog 428, AC Bog 429, AC Bog 430, AC Bog 431, AC Bog 433, AC Bog 434 and AC Bog 435. The experiment was laid out in a completely randomized design with three replications. The storage data were recorded periodically at 20 days interval (20 May, 08 June, 27 June, 16 July, 04 August, 23 August, 11 September, 30 September and 19 October) on rotting (%), sprouting (%), physiological loss in weight (PLW, %) and total loss (%) of bulbs. The results revealed that the genotypes/varieties had significant difference on the rotting, sprouting, PLW and total loss of bulbs. The genotype AC Bog 430 showed the lowest cumulative rotting loss (10.47%) but AC Bog 429 exhibited the highest cumulative rotting loss (39.47%). The maximum and minimum cumulative sprouting losses were recorded from AC Bog 434 (23.03%) and AC Bog 429 (1.47%). The BARI Piaz-1 had the lowest cumulative PLW (19.39%). However, the AC Bog 420 had the highest cumulative PLW (44.68%). The highest and the lowest cumulative total losses were calculated from the AC Bog 433 (79.99%) and AC Bog 430 (44.62%). The rate of storage loss was higher in May to July than that of August to October. The rotting, sprouting, PLW and total losses were increased with the increase of the onion storage period. The average rotting, sprouting, PLW and total losses were 20.71%, 13.71%, 29.87% and 64.29%, respectively for 5 and ½ months storage of onion under the study. The storage capacity was not correlated with the skin colour of onion. The dry matter content of bulb was found partial associated with the storage capacity.
Finally, under the present storability study, AC Bog 430 (44.62%), AC Bog 426 (45.28%), AC Bog 413 (47.13%) and BARI Piaz-1 (45.31%) showed good performance on the basis of total weight loss.

Keywords: Onion (*Allium cepa* L.), short-day, genotypes, varieties, ambient storage, storability, sprouting, rotting, physiological weight loss

Introduction
Onion (*Allium cepa* L.) is a seasonal perishable crop and has comparatively low storage ability. Onion bulbs are usually stored until the harvest of next season crop for steady supply round the year, getting the higher market price and production of true seeds using the bulbs in the next season. Several factors determine the shelf life and storability of onions, such as variety (Genetic trait), growing and harvesting conditions, post-harvest managements and storage conditions & duration (Sekara *et al*., 2017) [25]. Storage life of onion is affected by three principal characters such as physiological activity (transpiration, respiration, senescence, sprouting), biochemical activity (enzymatic, softness of tissue) and microbial invasion (fungi, bacteria), as described by Kumar *et al*. (2015) [16]. Storage temperature and relative humidity (RH) are two important factors which must be considered for storing the product successfully.

Onion is generally stored at two distinct storage temperature and humidity regimes i.e. 0-2 °C & 65-70% RH and 25-30 °C & 65-70% RH which are called ideal conditions for storing onions (Tripathi and Lawande, 2019) [28]. The second conditions (25-30 °C & 65-70% RH) prevail in tropical/sub-tropical countries which encourage more storage losses. Moreover, onion is normally stored under ambient conditions in most of the tropical countries under different types of structure where the storage losses are very high, as describes by Tripathi and Lawande (2019) [28]. Total post-harvest losses in onion ranged from 50-90%, 40-60% and 40-50% due to sprouting, physiological loss in weight and rotting, as noted by Toledo *et al*. (1984) and Tripathi and Lawande (2019) [28], respectively. A total of 25 short-day onion genotypes were collected from different sources. Already field evaluation of these genotypes on growth, development, yield and quality of these genotypes was conducted. Hence a storability study is very needed to select the advanced line/s. Therefore, the present study was undertaken for assessing storability of 25 genotypes along with existing varieties BARI Piaz-1 and BARI Piaz-4.

Materials and Methods

A total of 25 short-day onion genotypes along with two recommended varieties *viz*. BARI Piaz-1 and BARI Piaz-4 were evaluated at the bamboo-made ambient storage of Spices Research Sub-Centre, Bangladesh Agricultural Research Institute, Faridpur, Bangladesh in 2020 for testing their storability. All genotypes in the trial were evaluated under 25 accession lines such as AC Bog 409, AC Bog 410, AC Bog 411, AC Bog 412, AC Bog 413, AC Bog 414, AC Bog 415, AC Bog 416, AC Bog 417, AC Bog 419, AC Bog 420, AC Bog 421, AC Bog 422, AC Bog 423, AC Bog 424, AC Bog 425, AC Bog 426, AC Bog 427, AC Bog 428, AC Bog 429, AC Bog 430, AC Bog 431, AC Bog 433, AC Bog 434 and AC Bog 435. Bulbs of 27 genotypes/varieties were produced during winter (Rabi) season of 2019-2020 under an evaluation trial following proper procedures. The 40-day old uniform and healthy seedlings of 27 genotypes/varieties were transplanted on 18 December 2020 in the experimental plots. The bulbs of the genotypes/varieties were harvested on several days as per maturity symptoms. Harvesting was done up to 1st week of April, 2020. According to Khan and Rahman (2020) [11], the bulbs skin colour of 9 genotypes/variety (AC Bog 421, AC Bog 422, AC Bog 423, AC Bog 425, AC Bog 426, AC Bog 429, AC Bog 430, AC Bog 431 and BARI Piaz-1) were under bronze red while bulbs of 11 genotypes (AC Bog 409, AC Bog 411, AC Bog 412, AC Bog 414, AC Bog 415, AC Bog 416, AC Bog 420, AC Bog 428, AC Bog 433, AC Bog 434 and AC Bog 435) had light red colour. The bulbs of 5 genotypes (AC Bog 410, AC Bog 413, AC Bog 417, AC Bog 424 and AC Bog 427) exhibited pink red colour while remaining AC Bog 419 and BARI Piaz-4 both showed red in colour. In respect of bulb dry matter (DM) content, Khan and Rahman (2020) [11] also stated that eight genotypes (AC Bog 409, AC Bog 412, AC Bog 414, AC Bog 416, AC Bog 417, AC Bog 419, AC Bog 420 and AC Bog 427) had lower DM (From 10.66 to13.22%) and nine genotypes/variety (AC Bog 410, AC Bog 411, AC Bog 413, AC Bog 423, AC Bog 424, AC Bog 428, AC Bog 434, AC Bog 435 and BARI Piaz-4) gave medium DM (From 14.02 to16.87%). However, ten genotypes/variety (AC Bog 415, AC Bog 421, AC Bog 422, AC Bog 425, AC Bog 426, AC Bog 429, AC Bog 430, AC Bog 431, AC Bog 433 and BARI Piaz-1) had higher DM content (From 17.32- 19.88%). The healthy, sound and uniform bulbs were selected for testing the storability. Eighteen kilogram bulbs from each genotype/variety were taken under the study. The storability study was conducted under a completely randomized design with three replications. The onion bulbs were stored in ambient storage for 5 and ½ months from 01 May to 19 October, 2020. The storage maximum/minimum temperature and relative humidity (RH) were recorded two times daily at 6.00 am and 6.00 pm by placing Digital Thermo-Hygrometer (Model-Zeal, origin-England, made in China) in the ambient storage. But the average temperature and RH for nine periods were calculated (Table 1). The nine periods were 01-20 May, 20 May-08 June, 08-27 June, 27 June-16 July, 16 July-04 August, 04-23 August, 23 August-11 September, 11-30 September and 30 September-19 October. The storage data were recorded periodically at 20 days interval (20 May, 08 June, 27 June, 16 July, 04 August, 23 August, 11 September, 30 September and 19 October) on rotting (%), sprouting (%), physiological loss in weight (PLW, %) and total loss (%) of bulbs. The recorded data were analyzed statistically as suggested by Gomez and Gomez (1984) [9] and the means were compared by Duncan's Multiple Range Test.

Table 1: Periodical average max./min. temperature and relative humidity at ambient storage of Spices Research Sub-Centre, Faridpur during May to October, 2020

Average temperature/relative humidity		Periods								
		1-20 May	20 May-8 Jun.	8-27 Jun.	27 Jun.-16 Jul.	16 Jul.-4 Aug.	4-23 Aug.	23 Aug.-11 Sep.	11-30 Sep.	30 Sep.-19 Oct.
Temperature (°C)	Max.	34.75	31.83	33.07	32.07	30.10	30.80	30.80	31.06	31.52
	Min.	22.64	21.98	22.90	23.94	23.87	23.91	24.75	24.49	25.78
Relative humidity (%)	Max.	76.33	74.58	81.30	82.60	82.75	81.15	79.45	79.90	76.10
	Min.	43.16	42.82	43.00	51.45	57.70	55.15	56.40	52.30	56.55

Results and Discussion

Under the present experiment, periodical average temperature and relative humidity (RH) in the ambient storage were higher than those of ideal conditions (25-30 °C & 65-70% RH) which influenced significantly on the sprouting loss, physiological loss in weight (PLW), rotting loss and finally total weight loss in stored bulbs of short-day onion.

Sprouting loss: The genotypes/varieties influenced the sprouting loss significantly in every period of storage (Table 2). The cumulative sprouting loss in the period of 19 October ranged from 1.47 to 23.03%. The maximum and minimum cumulative sprouting losses were recorded from AC Bog 434 (23.03%) and AC Bog 429 (1.47%). The minimum sprouting loss was followed by AC Bog 420

(3.08%), AC Bog 422 (3.08%), AC Bog 425 (3.38%) and AC Bog 410 (3.83%). The maximum value was significantly followed by AC Bog 433 (21.56%), AC Bog 431 (20.69%) and AC Bog 427 (20.28%). After harvest, onions go through a rest period and they do not show visible cellular activity that is called dormancy. Dormancy depends on genetic cause of variety, harvesting season, maturity status at harvest, weather conditions at harvest (Specially rainfall), storage conditions (Temperature, relative humidity) etc. Here it is noted that last harvesting of onions was done in the first week of April, 2020. In the present trial, some genotypes (AC Bog 410, AC Bog 414, AC Bog 420, AC Bog 421, AC Bog 422, AC Bog 425 and AC Bog 429) showed longer dormancy due to lower respiration rate while other genotypes/varieties exhibited shorter dormancy due to higher respiration rate. Probably the harvested onions of other genotypes/varieties may be remained in a state of rest (Dormant) from April to first week of May based on the varietal potentials. Production technologies, harvesting, post-harvest management and storage conditions for all the genotypes/varieties were the same. So, the differences among the genotypes/varieties in sprouting loss might be due to genetic causes. Several researchers found different dormancy period of different onion varieties as 28-42 days (Khokhar, 2019) [12], 75 days (Grevsen *et al*., 2004) [10] and 42 days (Ddamularia *et al*., 2019) [8]. Both dormancy period and sprout growth rate vary depending on the cultivar and storage conditions (Chope *et al*., 2006) [7]. In the present study, the rate of sprouting was higher from May to July and then it was slower. The higher rate of sprouting during May to July may be due to prevailing higher temperature (over 30 ˚C but below 35 ˚C) during these months (Table 1). Maximum average temperature and relative humidity in all the periods were higher in present ambient storage (Table 1) than those of ideal conditions (25-30 °C & 65-70% RH). Among the periods, May to July showed comparatively much higher temperature but below 35 °C.

The sprouting loss increased with the increase of the storage period (Table 2). The current finding corroborates finding of Nabi *et al*. (2013) [19] who stated that sprouting percent increased with the increase of storage duration. The average sprouting loss in the period of 19 October was 13.71% for 5 and ½ months storage of onion (Table 1). Nabi *et al*. (2013) [19] found the maximum sprouting loss of onion (67.01%) for 4 months storage. while Laferriere *et al*. (1988) [17] recorded 8-10% sprouting loss in ambient storage. In Bangladesh Bisaws *et al*. (2010) found the maximum sprouting loss (6.80%) for 6 months in ambient storage.

Table 2: Influence of genotypes/varieties on cumulative sprouting loss (%) of onion bulb at Spices Research Sub-Centre, Faridpur during 20 May to 30 October, 2020

Genotypes /varieties	Periods (20 days interval)								
	20May	**08Jun.**	**27Jun.**	**16Jul.**	**04Aug.**	**23Aug.**	**11Sep.**	**30Sep.**	**19Oct.**
AC Bog 409	3.88b	6.92c	8.83d	10.30d-g	11.32g	12.99h	14.35f	15.10i	15.79h
AC Bog 410	0.41n	0.94k	1.24k	1.39k-m	1.74o	1.86p	2.04m	2.10q	3.83m
AC Bog 411	2.94e	5.06gh	8.25d-g	10.78d-f	11.03gh	13.83g	14.64f	15.14i	16.91fg
AC Bog 412	2.10h-j	6.82c	9.98c	11.68cd	13.01f	15.26f	15.60e	16.20fg	18.47e
AC Bog 413	2.05i-k	5.72ef	7.83g	9.54fg	9.93ij	10.72j	11.42hi	11.59l	12.34j
AC Bog 414	0.11o	0.32l	0.50l	1.85j-l	2.69lm	2.86n	3.37l	3.87o	4.97l
AC Bog 415	3.88b	7.75a	10.59a-c	13.10b	14.66cd	15.33e	15.89e	16.62ef	17.17f
AC Bog 416	3.25d	6.22d	8.52 d-f	10.22e-g	12.84f	14.73f	15.70e	15.91g	18.37e
AC Bog 417	3.22d	7.76a	10.92a	12.26bc	13.06f	15.21ef	15.57e	15.84g	16.02gh
AC Bog 419	2.54f	5.04h	7.62gh	11.59c-e	14.00e	15.57de	16.72d	17.79p	18.25e
AC Bog 420	0.05o	0.21l	0.27l	0.77lm	1.40o	2.15op	2.52m	2.96p	3.08m
AC Bog 421	0.60mn	1.12k	1.55k	2.59jk	3.08l	4.02m	5.67k	6.07n	6.68k
AC Bog 422	0.44mn	1.05k	1.27k	1.83j	2.45mn	2.58no	2.70lm	2.83p	3.08m
AC Bog 423	2.40fg	5.42f-h	7.86fg	8.13hi	10.62h	12.98h	14.80f	15.21hi	16.73fg
AC Bog 424	4.00b	7.10bc	10.14bc	13.73a	16.24a	18.22a	18.76ab	19.29c	19.70d
AC Bog 425	0.61m	0.94k	1.55k	1.86j	2.18n	2.62no	2.69lm	2.81p	3.38m
AC Bog 426	2.20hi	5.15gh	7.13hi	10.45d-g	11.38g	11.75i	12.48g	13.03k	13.53i
AC Bog 427	2.00jk	7.44ab	10.69ab	12.37bc	14.00e	16.41c	17.75c	19.19c	20.28cd
AC Bog 428	3.02e	5.52fg	8.61de	10.78d-f	12.87f	15.52de	16.91d	17.22de	19.48d
AC Bog 429	0.08o	0.13l	0.20l	0.28m	0.34p	0.68q	1.21n	1.38r	1.47n
AC Bog 430	1.68l	4.13i	6.86i	7.58i	8.04k	10.13k	10.31j	10.56m	11.85j
AC Bog 431	3.54c	6.02de	10.62a-c	12.99bc	14.40de	16.06cd	18.90a	20.38b	20.69bc
AC Bog 433	4.24a	7.12bc	10.55a-c	13.45ab	15.72b	16.21c	18.06bc	20.20b	21.56b
AC Bog 434	3.11de	5.02h	8.14e-g	12.50bc	15.01c	17.02b	18.27a-c	21.92a	23.03a
AC Bog 435	2.10h-j	4.03i	6.00j	9.08gh	10.01i	11.25ij	12.06gh	14.24j	16.13gh
BARI Piaz-1	1.88k	3.42j	5.63j	6.95i	8.02k	9.16l	10.67ij	11.32l	12.14j
BARI Piaz-4	2.27gh	3.74ij	6.07j	8.02hi	9.51j	10.89j	11.99gh	12.99k	15.25h
CV (%)	5.47	6.46	6.16	10.17	2.75	3.02	3.88	3.29	4.08
Level of sig.	**	**	**	**	**	**	**	**	**
Average	2.17	4.44	6.57	8.66	9.61	10.73	11.89	12.65	13.71

Footnote** Significant at 1% level of probability

Physiological weight loss: The genotypes/varieties had significant effect on the physiological loss in weight (PLW) in every period of storage (Table 3). The PLW in 19 October ranged from 19.19 to 44.68%. The AC Bog 413 had the lowest cumulative PLW (19.19%) insignificantly followed by BARI Piaz-1 (19.39%), AC Bog 426 (19.39%) and BARI Piaz-4 (20.77%). However, the AC Bog 420 had the highest cumulative PLW (44.68%) significantly followed by AC Bog 425 (37.99%) and AC Bog 421 (37.48%). The PLW (i.e. water loss from bulbs) depends on

the rate of transpiration, respiration, senescence and sprouting in onion bulbs. Increase of PLW due to high temperature under the present study is in agreement with the findings of several researchers. Rotting and re-growth (sprouting) increase the rate of respiration, heat generation and consequently enhance moisture loss and reduce the shelf life (Trevisan *et al*., 1999) [26]. Benkeblia *et al*. (2002) [4] disclosed that transpiration and heat production occurred in onion due to the catabolism when onion stored at ambient temperature (18-25˚C) and high humidity (>85%) conditions. Relative humidity of 65-75% is reported to be the most suitable for storing onions at any temperature (Ramin, 1999) [22]. But under the current trial, the Table 1 showed higher RH (>75%). By respiration process stored onions convert sugars and oxygen into higher carbon dioxide, water and heat ($C_6H_{12}O_2 + 6O_2 + 6CO_2 + 6H_2O$ + 2667 kj). The heat generated by the respiration process tends to increase the temperature of onions. This, in turn, increases the water vapor pressure just below the surface of onion, leading to increased transpiration (Sastry *et al*., 1978) [24]. By storing onions at high temperature, respiration is increased and senescence is hastened, thus deteriorating the storage life of onions. High storage temperature tends to increase weight loss by increasing the rate of respiration and water loss from bulbs (Biswas *et al*., 2010) [5]. The weight loss during storage varies from variety to variety as per the dormant period and physiological status of the bulbs which is directly related to the respiration rate (Brice *et al*., 1997) [6]. The difference in PLW could be due to genetic character among genotypes/varieties. The PLW increased with the increase of the storage period (Table 3). The average PLW in 19 October was 29.87% for 5 and ½ months storage of onion (Table 3). Weight loss of onion was increased with the increase in temperature and time in storage (Baninasab and Rahemi, 2006) [2]. They also observed wide variation between the onion varieties in weight loss. Under the current experiment, the rate of PLW was the maximum from May to July. After that it was declined. The probable causes of higher PLW rate during May-July might be due to prevailing higher temperature in this period (Table 1). The result is in accordance with Sharma *et al*. (2020) [29] who registered maximum PLW during May-July also. Benkeblia *et al*. (2000) [3] suggested that respiration rate increased linearly with increase in temperature. Laferriere *et al*. (1988) [17] observed 30-40% PLW at ambient conditions. In Bangladesh the maximum PLW (29.33%) was recorded by Bisaws *et al*. (2010) for 6 months of ambient storage.

Table 3: Influence of genotypes/varieties on cumulative physiological loss in weight (%) of onion bulb at Spices Research Sub-Centre, Faridpur during 20 May to 30 October, 2020

Genotypes /varieties	Periods (20 days interval)								
	20May	08Jun.	27Jun.	16Jul.	04Aug.	23Aug.	11Sep.	30Sep.	19Oct.
AC Bog 409	8.65a	13.77b	16.05f	19.52de	22.68d-g	24.53ef	26.38fg	27.51ij	29.32g-i
AC Bog 410	4.12f-h	8.23kl	12.54kl	15.82g-i	17.36kl	20.41h	20.62kl	22.92m	24.52kl
AC Bog 411	5.05d	10.65e-g	15.81f	18.88de	21.14gh	24.71ef	25.07g-i	27.56i	29.61g-i
AC Bog 412	5.12d	9.84g-j	12.93k	14.92ij	17.49j-l	20.38h	23.39ij	25.41j-l	27.04i-k
AC Bog 413	3.00i	7.86l	10.62mn	11.93kl	13.75m-o	14.62jk	16.79m	17.82o	19.19n
AC Bog 414	4.87de	9.03jk	13.32jk	17.03f-h	19.30h-j	22.00gh	24.70g-i	32.46c-e	33.64de
AC Bog 415	3.50hi	8.14l	12.95k	15.52ij	18.25i-k	20.55h	21.33jk	24.23lm	25.01jk
AC Bog 416	5.22d	10.71e-g	14.62g-i	17.18fg	19.76hi	22.38gh	24.10hi	27.62i	29.71g-i
AC Bog 417	4.88de	10.56e-h	15.61fg	18.15ef	21.73fg	24.00fg	26.67e-g	28.44g-i	30.53f-h
AC Bog 419	5.22d	10.97d-f	13.21jk	16.06g-i	19.37h-j	22.42gh	23.46i	25.17kl	27.95hi
AC Bog 420	4.30e-g	9.85g-j	27.03a	30.97a	32.10a	34.97a	36.81a	38.50a	44.68a
AC Bog 421	3.01i	9.61ij	14.52hi	19.35de	24.02e-g	29.71bc	32.07b	34.42bc	37.48bc
AC Bog 422	4.78d-f	11.71cd	17.39de	23.13c	24.00d	28.37cd	29.56cd	30.00f-h	31.12e-g
AC Bog 423	5.39d	13.72b	19.92c	23.67c	27.49bc	29.94bc	32.27b	34.04bc	36.97bc
AC Bog 424	5.27d	10.59e-g	15.57f-h	19.11de	23.67de	26.45de	29.56cd	32.95cd	34.49cd
AC Bog 425	4.99d	11.65cd	18.41d	23.01c	26.85bc	29.87bc	32.05b	35.72b	37.99b
AC Bog 426	3.12i	5.78m	8.09o	10.32m	13.78o	14.02k	16.93m	17.98o	19.39n
AC Bog 427	5.20d	10.41f-i	14.28ij	19.84d	23.46d-f	27.95cd	28.43de	31.09d-f	33.31de
AC Bog 428	7.56b	15.23a	21.75b	25.84b	28.36b	30.97b	31.23bc	33.11cd	35.32b-d
AC Bog 429	4.88de	8.21kl	12.39kl	16.27g-i	18.68i-k	21.50h	24.18hi	30.48e-g	31.35e-g
AC Bog 430	3.99gh	8.63kl	11.65lm	14.16j	16.15lm	17.28i	19.92kl	20.13n	22.30lm
AC Bog 431	6.87c	12.11c	19.72c	22.74c	26.36c	29.37bc	32.95b	34.36bc	35.45b-d
AC Bog 433	5.42d	11.35c-e	16.43ef	19.18de	21.68fg	24.71ef	28.03d-f	28.13hi	33.12d-f
AC Bog 434	5.12d	9.71h-j	12.61kl	15.29ij	19.00i-k	23.90fg	25.61gh	26.81i-k	27.31ij
AC Bog 435	3.55hi	8.00l	11.00m	15.66hi	19.22i-k	22.24gh	26.12f-h	27.99hi	29.66g-i
BARI Piaz-1	3.14i	5.15m	7.95o	10.65lm	13.83no	15.00jk	17.08m	18.88no	19.39n
BARI Piaz-4	3.88gh	5.32m	9.64n	12.68k	15.70l-n	16.17ij	18.74lm	20.34n	20.77mn
CV (%)	8.43	5.38	4.46	4.80	5.49	5.29	4.96	4.66	6.69
Level of sig.	**	**	**	**	**	**	**	**	**
Average	4.81	9.88	14.66	18.03	20.93	23.64	25.97	27.92	29.87

Footnote** Significant at 1% level of probability

Rotting loss: The rotting loss of onion was affected significantly in every period by the genotypes/varieties (Table 4). The cumulative rotting loss in 19 October ranged from 10.47 to 39.47% with the highest from AC Bog 429 and the lowest from AC Bog 430. The lowest value in AC Bog 430 was significantly followed by AC Bog 426 (12.36%) and BARI Piaz-1 (13.78%). In contrary, the highest rotting loss with AC Bog 429 was significantly followed by AC Bog 422 (30.77%), AC Bog 414 (26.72%) and AC Bog 410 (26.27%). The variation among the

genotypes/varieties in rotting loss might be due to genetic potentialities. Baninasab and Rahemi (2006) [2] recorded significant variation between the cultivars in rotting loss. The rotting loss increased with the increase of the storage period (Table 4). Nabi *et al*. (2013) [19] pointed out that rotting percent increased with the increase in storage duration. The average rotting loss in the period of 19 October was 20.71% for 5 and ½ months storage of onion (Table 4). Nabi *et al*. (2013) [19] and Bisaws *et al*. (2010) recorded 32.78% & 20.86% rotting loss for 4 & 6 months of ambient storage, respectively. Under the present experiment, temperature and RH were always higher in every period than those of ideal conditions for ambient storage. As a result, rotting loss in the present experiment may be due to infection of diseases. Working with three storing temperatures (15, 25 and 35˚C), Baninasab and Rahemi (2006) [2] stated that higher temperatures promoted the decaying loss of onion in storage. Rangaswami and Mahadevan (2004) [23] noted that in storage various diseases (black mould, bacterial soft rot, basal rot etc) destroy the onions but among these, black mould rot (*Aspergillus niger*) destroys at high temperature and high relative humidity, which environment was prevailing under the present study (Table 1). In the current study, maximum rotting was occurred during June-August due to mainly higher relative humidity along with higher temperature (Table 1). This finding is in partial agreement with the finding of Sharma *et al*. (2020) [29] who reported maximum rotting loss from July to August.

Table 4: Influence of genotypes/varieties on cumulative rotting loss (%) of onion bulb at Spices Research Sub-Centre, Faridpur during 20 May to 30 October, 2020

Genotypes /varieties	Periods (20 days interval)								
	20May	08Jun.	27Jun.	16Jul.	04Aug.	23Aug.	11Sep.	30Sep.	19Oct.
AC Bog 409	2.21 lm	4.75 n	7.98r	9.87q	11.57o	13.24o	15.40n	17.120	17.71 l
AC Bog 410	3.09 h	8.45 d	13.55f	18.81d	20.29d	21.71e	23.01e	24.55d	26.27d
AC Bog 411	3.32 g	6.52h	10.85h	11.86n	12.11n	13.77n	14.35n	17.29n	18.68n
AC Bog 412	4.89 c	7.74 f	10.59j	12.12m	13.79k	15.93l	17.08k	17.71m	19.38m
AC Bog 413	2.21 lm	5.85 jk	8.75o	10.79p	12.08n	13.64n	14.99m	15.32o	15.60s
AC Bog 414	5.11 b	9.83 c	15.93b	19.13c	22.35b	24.28c	25.04c	25.21c	26.72c
AC Bog 415	3.95 e	5.72 kl	10.46j	13.69i	16.37h	18.26i	20.15g	22.44i	22.77 l
AC Bog 416	2.86 j	7.14 g	8.00q	12.04mn	13.52l	15.12m	17.17k	17.55 m	19.71 l
AC Bog 417	4.88 c	8.17e	12.04g	14.53h	17.93f	19.43g	21.06f	23.60f	24.88g
AC Bog 419	2.89 ij	5.24m	7.14u	9.45r	10.34r	12.10p	13.70o	15.25o	16.85q
AC Bog 420	2.25lm	6.05ij	10.31l	13.00k	15.62i	17.31j	18.39i	19.31l	21.31j
AC Bog 421	1.23 p	4.82n	6.48w	8.70s	10.56q	11.30q	13.62o	14.87p	15.23t
AC Bog 422	4.40 d	9.74c	15.16c	19.97b	22.09c	24.84b	26.27b	27.52b	30.77b
AC Bog 423	2.11 m	4.95n	6.09z	8.27tu	10.79p	11.13q	13.67o	14.13r	16.49r
AC Bog 424	2.66 k	5.35m	8.02p	11.19o	12.4m	15.17m	17.24k	19.92k	20.50k
AC Bog 425	3.05 hi	7.22g	14.30e	17.77e	19.73e	22.63d	23.88d	24.09e	25.54e
AC Bog 426	1.06 q	3.81p	6.89v	7.98v	8.51u	9.26t	10.54s	11.09u	12.36w
AC Bog 427	3.55 f	7.84f	10.36k	15.43g	19.75e	21.41f	23.85d	24.07e	25.12f
AC Bog 428	2.26lm	7.85f	10.09m	13.22j	15.40j	16.40k	18.09j	21.62j	22.88i
AC Bog 429	9.00 a	19.65a	25.60a	30.56a	33.70a	35.58a	37.33a	38.13a	39.47a
AC Bog 430	1.77 n	3.77p	5.55A	6.54x	6.95v	7.59u	8.53t	9.86v	10.47x
AC Bog 431	2.11 m	6.14i	9.29n	12.30l	15.79i	16.32k	19.46h	22.81h	23.82h
AC Bog 433	5.00 bc	11.82b	14.84d	16.09f	17.29g	18.77h	21.00f	23.05g	25.31f
AC Bog 434	1.22 pq	5.45lm	7.65t	8.46t	9.16t	10.81r	12.22p	14.38q	15.78s
AC Bog 435	1.45 o	4.77n	6.13y	8.09ul	10.00s	11.12q	11.99q	13.88s	14.41u
BARI Piaz-1	1.15 pq	4.25o	6.29x	7.38w	8.67u	10.55s	11.00r	12.39t	13.78v
BARI Piaz-4	2.33 l	5.35m	7.69s	9.67q	11.70o	12.08p	14.38n	15.11o	17..41p
CV (%)	8.3	6.18	6.09	9.01	5.88	9.80	6.73	7.67	5.63
Level of sig.	**	**	**	**	**	**	**	**	**
Average	3.03	6.97	10.22	12.84	14.76	16.28	17.90	19.34	20.71

Footnote** Significant at 1% level of probability

Total weight loss: The total weight loss of onion was significantly affected due to different genotypes/varieties (Table 5). The total weight loss in the period of 19 October ranged from 44.62 to 79.99%. The highest and the lowest cumulative total losses were obtained from the AC Bog 433 (79.99%) and AC Bog 430 (44.62%) in the end of the storage. The lowest total weight loss was insignificantly followed by AC Bog 426 (45.28%), BARI Piaz-1 (45.31%) and AC Bog 413 (47.13%). While the highest total weight loss was insignificantly followed by the AC Bog 431 (79.96%), AC Bog 427 (78.71%) and AC Bog 428 (77.68%). The variation among the genotypes/varieties in total weight loss might happen due to their differences in rotting, sprouting and physiological weight loss. Sharma *et al*. (2020) [29] opined that variety influenced storage life of onion. The total weight loss increased with the increase of the storage period (Table 5). Storage loss increased with the increasing time in storage (Baninasab and Rahemi, 2006) [2]. The average total weight loss in the period of 19 October was 64.29% for 5 and ½ months storage of onion (Table 5). In the current trial, most of the loss (29.87%) was due to PLW (Table 3). Biswas *et al*. (2010) [5] and Nabi *et al*. (2013) [19] claimed 56.72% & 65.62% total loss of onion due to rotting, sprouting and physiological weight loss for 6 & 4 months in ambient storage, respectively. While, Rabbani *et al*. (1986) [20] found 66% total loss of onion under ambient storage. Considering colour of bulb, some bronze red genotypes/variety e.g. AC Bog 430 (44.62%), AC Bog 426

(45.28%) and BARI Piaz-1 (45.31%) showed good storage performance, while other bronze red genotypes had inferior performance on shelf life. The AC Bog 413 bearing pink red colour exhibited good storage performance. However, remaining genotypes/variety with different skin colour including bronze red showed higher cumulative total loss of bulb. The variation among the colour based genotypes/varieties might be due to unknown genetic potential. The present finding is line with the finding of Ko *et al*. (2002) [15] who stated that bulb skin colour was not associated with storage loss. But the current finding is disagreement with the finding of Tripathi and Lawande (2010) [27], Adamicki (2005) [1] and Rabino witch and Currah (2002) [21]. They opined that varietal skin colour influenced the storability of onion. Tripathi and Lawande (2010) [27] found comparatively better storage capacity of light red colour onion due to lower respiration rate than that of in dark red onion varieties. In case of bulb dry matter (DM) content, the genotypes/variety with higher DM content such as AC Bog 430 (44.62%), AC Bog 426 (45.28%), BARI Piaz-1 (45.31%) had low cumulative total loss of onion, while genotypes with higher DM content showed inferior performance in storage. In addition, the genotype AC Bog 413 (47.13%) with comparative low DM content exhibited good performance in storage. Here it is noted that the genotypes with inferior content of DM never showed good performance. Adamicki (2005) [1] and Rabino witch and Currah (2002) [21] found good performance with the varieties having higher DM content. A higher DM content means a lower water content in bulbs, which reduces the metabolic activities in the bulbs and prolongs the dormancy period (Lazic *et al*., 2000) [18].

Table 5: Influence of genotypes/varieties on cumulative total loss (%) of onion bulb at Spices Research Sub-Centre, Faridpur during 20 May to 30 October, 2020

Genotypes /varieties	Periods (20 days interval)								
	20May	**08Jun.**	**27Jun.**	**16Jul.**	**04Aug.**	**23Aug.**	**11Sep.**	**30Sep.**	**19Oct.**
AC Bog 409	14.74a	25.44c-e	32.86de	39.69f-h	45.57ef	50.76kl	56.13g-i	59.73f-h	62.82ij
AC Bog 410	7.62k-m	17.62no	27.33gh	36.02ij	39.39h	43.98m	45.67k	49.57j	54.62l
AC Bog 411	11.31d-f	22.23ij	34.91d	41.52e-g	44.28e-g	52.31g-k	54.06h-j	59.99f-h	65.20g-i
AC Bog 412	12.11cd	24.40e-g	33.50de	38.72g-i	44.29e-g	51.57j-l	56.07g-i	59.32gh	64.89g-i
AC Bog 413	7.26l-n	19.43l-n	27.20hi	32.26k	35.76ij	38.98n	43.20kl	44.73k	47.13m
AC Bog 414	10.09f-h	19.18mn	29.75fg	38.01hi	44.34e-g	49.14l	53.11ij	61.54e-g	65.33g-i
AC Bog 415	11.33d-f	21.61jk	34.00d	42.31d-f	49.28d	54.14f-j	57.37f-i	63.29e	64.95g-i
AC Bog 416	11.33d-f	24.07f-i	31.14ef	39.44f-i	46.12e	52.23h-k	56.97f-i	61.08e-h	67.79fg
AC Bog 417	12.98bc	26.49cd	38.57b	44.94b-d	52.72c	58.64d	63.30cd	67.88d	71.43de
AC Bog 419	10.65e-h	21.25j-l	27.97gh	37.10hi	43.71fg	50.09kl	53.88h-j	58.21hi	63.05h-j
AC Bog 420	6.60mn	16.11o-q	37.61cd	44.74b-e	49.12d	54.43f-i	57.72f-h	60.77e-h	69.07ef
AC Bog 421	4.84o	15.55p-r	22.55i-k	30.64kl	37.66hi	45.03m	51.36j	55.36i	59.39k
AC Bog 422	9.62g-j	22.50h-j	33.82de	44.93b-d	48.54d	55.79ef	58.53e-g	60.35e-h	64.97g-i
AC Bog 423	9.90g-i	24.09f-i	33.87de	40.07f-h	48.90d	54.05f-h	60.74d-f	63.38e	70.19de
AC Bog 424	11.93c-e	23.04g-j	33.73de	44.03c-e	52.40c	59.84cd	65.56c	72.16bc	74.69bc
AC Bog 425	8.65i-k	19.81k-m	34.26d	42.64d-f	48.76d	55.12e-g	58.62e-g	62.62ef	66.91fg
AC Bog 426	6.38mn	14.11rs	22.11jk	28.75l	33.67j	35.03o	39.95lm	42.10kl	45.28m
AC Bog 427	10.75e-g	25.69d-f	35.33d	47.64ab	57.21a	65.77a	70.03ab	74.35ab	78.71a
AC Bog 428	12.84bc	28.6ab	40.45ab	49.84a	56.63ab	62.89b	66.23bc	71.95bc	77.68ab
AC Bog 429	13.96ab	27.99bc	38.19bc	47.11a-c	52.72c	57.76de	62.72c-e	69.99cd	72.29cd
AC Bog 430	7.44k-n	16.53op	24.06ij	28.28lm	31.14k	35.00o	38.76m	40.55l	44.62m
AC Bog 431	12.52cd	24.27e-h	39.63ab	48.03ab	56.55ab	61.75bc	71.31a	77.55a	79.96a
AC Bog 433	14.66a	30.29a	41.82a	48.72a	54.69bc	59.69cd	67.09a-c	71.38bc	79.99a
AC Bog 434	9.45h-j	20.18k-m	28.40fg	36.25i	43.17g	51.73i-l	56.10g-i	63.11e	66.12f-h
AC Bog 435	7.10mn	16.80op	23.13ij	32.83jk	39.23h	44.61m	50.17j	56.11i	60.20jk
BARI Piaz-1	6.17n	12.82s	19.87k	24.98m	30.52k	34.71o	38.75m	42.59kl	45.31m
BARI Piaz-4	8.48j-l	14.41q-s	23.40ij	30.37kl	36.91i	39.14n	45.11k	48.44j	53.43l
CV (%)	7.80	5.44	5.58	5.17	5.12	5.40	4.84	5.09	6.00
Level of sig.	**	**	**	**	**	**	**	**	**
Average	10.02	21.27	31.46	39.25	45.30	50.89	55.50	59.92	64.29

Footnote** Significant at 1% level of probability

Conclusion

Based on the present study it could be concluded as follows:

- The rate of storage loss was higher in May to July than that of August to October.
- The rotting, sprouting, PLW and total losses increased with the increase of the storage period of onion.
- The average rotting, sprouting, PLW and total losses were 20.71%, 13.71%, 29.87% and 64.29%, respectively for a period of 5 and ½ months storage of onion under the study.
- The storage capacity was not correlated with the skin colour of onion.
- The dry matter content of bulb was found partial associated with the storage capacity.
- Out of 27 genotypes/varieties, the genotype AC Bog 430 (44.62%), AC Bog 426 (45.28%), AC Bog 413 (47.13%) and the variety BARI Piaz-1 (45.31%) showed good performance in respect of total weight loss.

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References

1. Adamicki F. Effects of pre-harvest treatments and storage conditions on quality and shelf-life of onions. Acta Hort. 2005;688:229-238.
2. Baninasab S, Rahemi M. The effect of high temperature on sprouting and weight loss of two onion cultivars. Amer. J. Plant Physiol. 2006;1(2):199-204.
3. Benkeblia N, Varoquaux P, Gouble B, Selselet-Attou G. Respiratory parameters of onion bulbs (*Allium cepa*) during storage. Effects of ionizing radiation and temperature. J Sci. Food and Agri. 2000;80(12):1772-1778.
4. Benkeblia N, Varoquaux P, Shiomi P, Sakai H. Storage technology of onion bulbs c.v. Rouge Amposta: effects of irradiation, maleic hydrazide and carbamate isopropyi, N-phenyi (CIP) on respiration rate and carbohydrates. Inter. J Food Sci. Technol. 2002;37(2):169-176.
5. Biswas SK, Khair A, Sarkar PK, Alom MS. Yield and storability of onion (*Allium cepa* L.) as affected by varying levels of irrigation. Bangladesh J Agric. Res. 2010;35(2):247-255.
6. Brice J, Currah L, Malins A, Bancroft R. Onion Storage in the Tropics: A Practical Guide to Methods of Storage and Their Selection. Chatham, UK. Natural Resources Institute; c1997.
7. Chope GA, Terry LA, White PJ. Effect of controlled atmosphere storage on abscisic acid concentration and other biochemical attributes of onion bulbs. Post-harvest Biol. Technol. 2006;39(3):233-242.
8. Ddamulira G, Kalali F, Maphosa M. Yield and storage performance of onion (*Allium cepa* L.) genotypes under in-situ and ex-situ conditions. Inter. Plant and Soil Sci. 2019;30(4):1-7.
9. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research (2nd edition). John Wiley and Sons, New York, USA, 1984, 680.
10. Grevsen K, Sorensen JN. Sprouting and yield in bulb onions (*Allium cepa* L.) as influenced by cultivars, plant establishment methods, maturity at harvest and storage conditions. J. Hortic. Sci. Biotech. 2004;79(6):877-884.
11. Khan MA, Rahman MM. Collection, conservation and evaluation of onion germplasm. Annual Research Report 2019-2020, Spices research Centre, Bangladesh Agricultural Research Institute, Shibganj, Bogura, 2020, 4-15.
12. Khokhar KM. Onion-An Ancient Crop and Modern Practices: A Review. Noor Publishing, Pakistan, 2019, 608.
13. Ibrahim NS, AI Abdalla, GH Mohamedali, Khiery NT. Correlation study of physicochemical properties of some Sudanese onion genotypes (*Allium cepa* L.). Int. J Hortic Food Sci 2022;4(2):194-198. DOI: 10.33545/26631067.2022.v4.i2c.124
14. Ko SS. Identification of good storability in short day onion and its mechanism of resistance to *Aspergillus niger*. Ph. D. Thesis, National Chung Hsing Univ., Taichung, Taiwan, Republic of China; c2001.
15. Ko SS, Chang WN, Wang JF, Cherng SJ, Cherng SJ, Shanmugasundaram S. Storage variability among short-day onion cultivars under high temperature and high relative humidity and its relationship with disease incidence and bulb characteristics, J. Amer. Soc. Hort. Sci. 2002;127(5):848-854.
16. Kumar V, Neeraj, Sharma S, Sagar NA. Post-harvest management of fungal diseases in onion-A review. Inter. J Current Microbio. and App. Sci. 2015;4(6):737-752.
17. Laferriere JM, Frapasance J, Khan MH. CIDA identification and planning mission for assistance in post-harvest management of fruits and vegetables in Pakistan. Canadian International Development Agency (CIDA), CIDA Report No, 1988, 17.
18. Lazic B, Djurovka M, Gvozdenovic J. Uticaj ekoloskih Uslova I Agrotehnickih Mera Na Prinos I Kvalitet Crnog Luka. Zbornik radova instituta za ratarstvo i povrtarstvo. Sv. 2000;33:135-144.
19. Nabi G, Rab A, Sajid M, Farhatullah S, Abbas J, Ali I. Influence of curing methods and storage conditions on the post-harvest quality of onion bulbs. Pak. J Bot. 2013;45(2):455-460.
20. Rabbani MG, Hussain A, Siddique MA, Faruque AHM. Yield and storability of seven onion (*Allium cepa* L.) cultivars. Bangladesh J Agric. 1986;11(4):1-7.
21. Rabinowitch HD, Currah L. Allium Crop Science: Recent Advances, CAB International, Wallingford, UK, 2002, 515.
22. Ramin AA. Storage potential of bulb onions (*Allium cepa* L.) under high temperatures. J. Hort. Sci. Biotechnol. 1999;74(2):181-186.
23. Rangaswami G, Mahadevan A. Diseases of crop plants in India. Prentice-Hall of India Private Limited; c2004. New Delhi-110001.
24. Sastry SK, Baird CD, Buffington DE. Transpiration rates of certain fruits and vegetables. ASHRAE Transactions. 1978;84(1):237-254.
25. Sekara A, Pokluda R, Vacchio LD, Somma S, Caruso G. Interactions among genotype, environment and agronomic practices on production and quality of storage onion (*Allium cepa* L.). A review. Hort. Sci. (Prague). 2017;44(1):21-42.
26. Trevisan JN, Martins GAK, Lopes SJ, Garcia DC. Yield and post-harvest storability of lowland grown onion genotypes. Ciencia Rural. 1999;29(3):409-413.
27. Tripathi PC, Lawande KE. Temperature related changes in respiration and Q_{10} coefficient in different varieties of onion. Progr. Hort. 2010;42(1):88-90.
28. Tripathi PC, Lawande KE. Onion storage in tropical region: A review. Current Hort. 2019;7(2):15-17.
29. Sharma S, Zhang M, Gao J, Zhang H, Kota SH. Effect of restricted emissions during COVID-19 on air quality in India. Science of the total environment. 2020 Aug 1;728:138878.
30. Barman GD, Verma SK, Raj S, Bisen RK. Impact of different organic and inorganic fertilizers with varying sulphur doses on growth and yield of onion (*Allium cepa* L.) in Bilaspur, Chhattisgarh region, India.