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STORABILITY OF DIFFERENT SIZES OF POTATO TUBERS UNDER NATURAL CONDITION

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Abstract

An investigation was conducted at the Tuber Crops Research Sub Centre of BARI, Munshiganj to study the storability of different sizes of potato varieties under natural condition. Large, medium, and small sized tubers of 15 potato varieties viz., Asterix, BARI TPS-1, Cardinal, Courage, Diamant, Esprit, Felsina, Granola, Lady Rosetta, Provento, Meridian, Quincy, Sagitta, Spunta, and Omega were included in the investigation. Results revealed that cumulative weight loss was higher in small sized tubers (<28 mm) compared to that of large (>55 mm) and medium (28-55 mm) sized tubers during 120 days of storage (DAS). Sprout initiation and shriveling also started earlier in small sized tubers irrespective of varieties. Therefore, small tubers were not suitable for storing under natural condition. Cumulative weight and rotting loss were recorded higher in the variety BARI TPS-1 and Felsina compared to that of other varieties, which indicated the unsuitability of storing these two varieties under natural condition. On an average, 18.49% cumulative weight loss at 150 DAS was recorded in all the varieties irrespective of size. Large and medium sized potato could be stored under natural condition for 150 days with 7.63% total rotting loss.

Keywords: Potato, storability, variety, tuber size.

Introduction

Potato *(Solanum tuberosum)* production in our country is increasing day-by-day. In the year 2009-10, the total potato production in Bangladesh was about 9.0 million tons from 0.50 million hectares, while national average yield was about 18.0 t/ha. Whereas, in the year 2014-15, total potato production raised up to 9.25 million tons from 0.472 million hectares. Therefore, per hectare potato production becomes around 19.6 tons (BBS, 2016). Although, potato production in Bangladesh has increased but other facilities have not yet developed like marketing system, storage facilities and consciousness of the farmers regarding use of huge amount of fertilizers, pesticides, etc. Therefore, cost of production increases and farmers do not get appropriate price of the produced tubers in the seasonal glut (Hoque, 2011). Producers cannot even store the potatoes in the cold storage to sell the tubers in the off-season at a high price. At present, we have 375 cold storages in our country with hardly a capacity of storing 2.5 million tons of potatoes in those cold storages. Considering the total cold storage capacity and production of potato in the country, at present 25-30% of the total produced potatoes in the country can only be preserved in the cold stores (Rabbani *et al*., 2010; Hoque and Akter, 2014). So, storing potato is now-a-days number one problem

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in our country as we have no adequate cold storages. Therefore, farmers are bound to sale their perishable potatoes immediately after harvest at lower price or they store naturally in the field or in their houses; where, they can hardly store for 2 months, but a large amount of potato tubers are spoiled (Hoque, 2014). The growers, however, still prefer to store the tubers at home even during the hottest period (April-August) in order to sell them gradually, and consequently at a high price (Bhattacharjee *et al*., 2014).

The Tuber Crops Research Centre (TCRC) of Bangladesh Agricultural Research Institute has released a good number of potato varieties. These varieties have been released mainly on the basis of their high yield and processing quality (Hoque, 2014). Majority of these varieties can be stored well in cold storage but perform variably under natural condition. Among these varieties, only Ailsa, which is originated in UK, was released on the basis of its high yield and storability under natural condition. But unfortunately, Ailsa did not get popularity among the farmers due to its lower storability under cold storage condition. Moreover, the seeds of Ailsa are not available now-a-days. On the other hand, different sizes of tubers may affect the storability of potatoes. Immature potato tubers that are smaller in size compared to the larger ones during harvest have higher evaporative water loss than matured tubers, and water loss due to evaporation leads to loss in turgidity within cells (Bussan *et al*., 2009). Therefore, the present investigation has been conducted to study the storability of different sizes of potato varieties under natural condition.

Materials and Methods

Tubers of 15 potato varieties viz., Asterix, BARI TPS-1, Cardinal, Courage, Diamant, Esprit, Felsina, Granola, Lady Rosetta, Provento, Meridian, Quincy, Sagitta, Spunta, and Omega were stored in wooden rack each with three sizes viz., large (>55mm), medium (28-55mm), and small (<28mm) at the Tuber Crops Research Sub Center, Bangladesh Agricultural Research Institute (BARI), Munshiganj. In each variety, 10 apparently healthy tubers from each size were stored in well ventilated and insect proof netted wooden rack under diffused light. The tubers were marked individually from 1 to 10 and initial weight of each tuber was recorded. Therefore, (a) initial total weight was calculated by adding initial weight of all ten tubers; (b) weight loss from each tuber at 30 days interval was also recorded up to 150 days and total weight at respective date was recorded by adding weight of all healthy tubers except the rotten ones, (c) the rotten tubers were sorted out after taking total weight . Finally, weight loss (%) at respective days after storing was calculated, and using these, cumulative weight loss at respective date was worked out. Similarly, rotting loss in each date was calculated and expressed as percentage. Following formulae were used to calculate weight and rotting loss.

Weight loss (%) at respective DAS $= \frac{a-b}{a} \times 100$

Where, a= initial total weight (g)
b= total weight of healthy tubers at respective date (g)

Rotting loss (%) at respective DAS= $\frac{c}{a} \times 100$

Where, a= initial total weight (g)
c= total weight of rotten tuber at respective date (g)

Besides, disease and insect infestation was observed and days to start shriveling and sprout initiation were also recorded. Experiment was set up on 06 March 2012 and 01 March 2013 following a 2-factor Completely Randomized

Design (CRD) with 3 replications. Data were analyzed with MSTATC program and means were separated by Duncan's Multiple Range Test (DMRT) at 1% level of significance.

Results and Discussion

Storage performance of different varieties of potato has been presented in Table 1. Performance of different varieties significantly varied when stored under natural condition. At 30 days after storing (DAS), the highest weight loss was recorded in the variety Provento (3.72%), which was statistically similar with the loss recorded in BARI TPS-1 (3.60%), Diamant (3.28%), Lady Rosetta (3.36%), and Meridian (3.12%). The lowest weight loss at 30 DAS was recorded in Sagitta (1.56%). The cumulative weight loss in the studied varieties at 60 DAS was concentrated to mean (5.12%). At this time, the highest weight loss was also recorded in Provento (6.13%) followed by that in Felsina (5.96%), Lady Rosetta (5.90%), BARI TPS-1 (5.84%), Meridian (5.65%), Diamant (5.61%) and Cardinal (5.36%). The lowest weight loss at 60 DAS was recorded in Sagitta (4.15%). A range of 4.79-6.28% weight loss at 60 DAS in studied exotic varieties was recorded in Nowroz (2015), which confirmed the result of present investigation. However, in the subsequent days, the cumulative weight loss was the highest in BARI TPS-1 (10.29% at 90 DAS, 14.73% at 120 DAS and 24.61% at 150 DAS), which was statistically similar with the loss of Felsina (10.0% at 90 DAS, 13.28% at 120 DAS and 22.20% at 150 DAS). This result implied the poor standard of Felsina and BARI TPS-1 for storing under natural condition. Chandra *et al.* (2017) worked with different potato varieties and found a non-significant effect on weight loss of tuber up to 60 days of storage, but after 90 days of storage, the

Table 1. Cumulative weight loss of different potato varieties under natural condition

Variety	Cumulative weight loss (%) at					Days to sprout initiation	Days to start shriveling
	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS		
Asterix	2.55 efg	4.66 de	6.57 bcd	10.06 cde	19.09 bcd	59.67 d	61.89 c
BARI TPS-1	3.60 ab	5.84 ab	10.29 a	14.73 a	24.61 a	47.00 i	48.22 h
Cardinal	2.98 b-e	5.36 a-d	7.03 bcd	11.23 bcd	18.72 bcd	64.67 b	65.44 b
Courage	2.75 c-f	4.75 cde	5.92 cd	8.31 ef	15.69 cde	51.56 gh	51.56 fg
Diamant	3.28 a-d	5.61 abc	7.03 bcd	10.29 cde	18.08 b-e	63.89 c	64.89 b
Esprit	2.66 d-g	4.99 b-e	6.95 bcd	10.85 b-e	18.23 b-e	58.00 e	57.78 e
Felsina	3.03 b-e	5.96 a	10.0 a	13.28 ab	22.20 ab	46.89 i	47.67 h
Granola	2.63 d-g	4.56 de	5.52 d	7.32 f	14.27 e	67.67 a	68.33 a
Lady Rosetta	3.36 abc	5.90 ab	7.23 bc	9.82 de	15.87 cde	66.22 ab	66.67 ab
Provento	3.72 a	6.13 a	7.47 bc	9.65 def	18.48 bcd	59.44 d	59.67 d
Meridian	3.12 a-e	5.65 abc	7.96 b	12.50 abc	20.20 b	56.00 f	57.22 e
Quincy	2.08 fgh	4.68 de	7.20 bc	11.28 bcd	18.08 b-e	52.56 g	53.44 f
Sagitta	1.56 h	4.15 e	6.37 bcd	10.20 cde	19.22 bcd	49.33 h	51.00 g
Spunta	2.03 gh	4.23 e	6.21 cd	9.88 de	19.41 bc	50.89 gh	51.22 g
Omega	2.45 efg	4.41 de	5.95 cd	9.47 def	15.18 de	60.00 d	61.22 cd
Mean	2.79	5.12	7.18	10.59	18.49	56.919	57.75
CV (%)	12.9	13.36	10.3	12.6	10.37	5.63	5.47

Means followed by same letter(s) in a column do not differ significantly at 1% level by DMRT

variation was significant. They recorded 8.61 to 9.02% weight loss at 90 DAS, which was very close to the present findings. Azad *et al*. (2017) recorded the highest (18.83%) loss in the variety Felsina at 120 DAS when stored under ambient condition. The average loss in the varieties after 150 days was 18.49%. Ali and Huq (2002) reported 18.06% loss in different varieties after five months of storage; while, Khan (1991) estimated 21% loss in different varieties. Varying levels of tuber rotting from variety to variety at different days after storage under ambient condition were also reported by Biswal and Dhal (2014). Days to sprout initiation and days to start shriveling also varied significantly in the varieties. These two criteria are very important for natural storage of potato. The variety in which the tuber takes more time to sprout initiation and start shriveling during storage is expected as dormancy period of varieties gives information about how long the tubers will be stored before it initiates sprouting and start to shrivel. However, the variety Granola performed better and took the highest time to initiate sprout (67.67 days) and shriveling 68.33 days), which indicated the suitability of this variety for storing under natural condition. The varieties BARI TPS-1 and Felsina took less than 50 days for sprouting and shrinkage; which indicated the non-suitability of these two varieties for storing under natural condition. This result was in agreement with the findings of Bhattacharjee *et al*. (2014), where they recorded 51.67 days for starting of sprout in BARI TPS-1.Van and Hartmans (1987) reported that sprouted potatoes loose much more weight than un-sprouted potatoes. This statement was in line with the present findings; where, Felsina and BARI TPS-1 took less time to sprout and lost much more weight compared to that of other varieties. Roy *et al.* (2006) recorded a range of 41.8 to 54.0 days for sprout initiation in different TPS progenies.

Regarding size of tubers, it was observed that cumulative weight loss was higher in small sized tubers at all the observed dates (Table 2). This might be due to (i) lower dry matter in the small tubers compared to large sized tubers as the small tubers are comparatively immatured than medium and large tubers or (ii) higher surface area in small tubers than large with similar weight that resulted more lenticels in small tubers and ultimately higher avenue to loss water during different metabolic activities. Bussan *et al.* (2009) reported to have higher weight loss in small sized potato tubers that are relatively immatured than larger ones. They urged that immatured potato tubers have

Table 2. Cumulative weight loss of different sizes of potato tubers under natural condition

Size	Cumulative weight loss (%) at					Days to sprout initiation	Days to start shriveling
	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS		
Large	2.78 ab	4.87 b	6.74 b	10.03 b	16.72 b	57.24 a	57.91 a
Medium	2.57 b	4.70 b	6.50 b	9.93 b	18.06 b	56.98 a	57.98 a
Small	3.01 a	5.81 a	8.30 a	11.82 a	20.69 a	56.53 b	57.36 b
Mean	2.79	5.12	7.18	10.59	18.49	56.919	57.75
CV (%)	12.9	13.36	10.3	12.6	10.37	5.63	5.47

Means followed by same letter(s) in a column do not differ significantly at 1% level by DMRT

higher evaporative water loss than matured tubers, and water loss due to evaporation leads to loss in turgidity within cells, which was in agreement with the present findings. Roy *et al.* (2006) reported that weight loss of healthy tubers increased with increasing tuber size in different true potato seed (TPS) progenies. They found minimum weight loss in small sized tubers followed by that of the medium and large ones. This result differed with the findings of present investigation. This might be because of differences in varieties and TPS progenies. In case of days to sprout initiation and days to start shriveling, large and medium sized tubers performed better than small sized tubers. Sprout was initiated earlier (56.53 days) in small sized tubers followed by that in medium (56.98 days) and large (57.24 days) sized tubers. Shriveling was also started earlier in the small sized tubers (57.36 days) followed by that in large (57.91 days) and medium (57.98 days) sized tubers. Roy *et al.* (2006) also observed the earlier shriveling in small sized tubers which substantiated the findings of the present investigation. The earlier sprouting and shriveling in small sized tubers indicated the non-suitability of storing small sized tubers under natural condition. Practically, it was observed that there are little gaps in between small sized tubers which might affect negatively on air movement among stored tubers.

Performances of different potato varieties and tuber size when stored under natural condition are presented in Table 3. It was observed in all the varieties that cumulative weight loss was higher in small sized tubers compared to that in medium and large sized tubers. At 30 DAS, the highest weight loss (4.38%) was recorded in large sized tubers of BARI TPS-1 and the lowest in large sized tubers of Sagitta (1.39%). At 60 DAS, the highest weight loss (7.02%) was recorded in small sized tubers of Meridian and the lowest in large sized tubers of Spunta (3.23%). At 90 DAS, the highest cumulative weight loss (13.16%) was recorded in small sized tubers of Felsina, which was statistically similar to the loss obtained in small sized tubers of BARI TPS-1 (11.55%) and the lowest in large sized tubers of Spunta (4.60%). It was also observed that the cumulative weight loss was rapid after 120 days of storage in all the varieties. However, the highest cumulative weight loss of 16.98% and 28.59% at 120 and 150 DAS, respectively were recorded in small sized tubers of BARI TPS-1, which was very close and statistically similar to the cumulative loss recorded in same sized tubers of Felsina (16.56% at 120 DAS and 26.83% at 150 DAS).The lowest cumulative weight loss at that time was recorded in large sized tubers of Granola (6.79% at 120 DAS and 13.02% at 150 DAS). On an average, 18.49% cumulative weight loss at 150 DAS was recorded in all the varieties irrespective of sizes.These results indicated that no variety should be stored for 150 days under natural condition except Granola. Many researchers also recorded differential responses in storability of different cultivars or genotypes (Hossain and Rashid, 1991; Hossain *et al.,* 1992; Long *et al.,* 2004; Roy *et al.,* 2006; and Azad *et al*., 2017). In case of days to sprout initiation, the variety Granola performed the best compared to other varieties and it took the highest time for sprout initiation (68.00 days in large sized, 67.67 days in medium sized and 67.33 days for small sized tubers). Performance of Lady Rosetta regarding days to sprout initiation was very close and statistically similar to Granola

Table 3. Cumulative weight loss of different potato varieties and sizes under natural condition

Variety	Size	Cumulative weight loss (%) at					Days to sprout initiation	Days to start shriveling
		30 DAS	60 DAS	90 DAS	120 DAS	150 DAS		
Asterix	Large	2.54d-k	4.60f-l	6.79e-j	10.30b-h	17.33d-h	60.33 f	62.33 g
	Medium	2.61c-k	4.61f-l	6.17f-j	9.84 b-h	18.93c-h	60.00 f	62.33 g
	Small	2.51d-k	4.77e-l	6.77e-j	10.02b-h	21.01b-g	58.67 fg	61.00 gh
BARI TPS-1	Large	4.38 a	6.35a-f	10.17bc	13.03a-e	20.10b-h	46.00 s	48.67 pqr
	Medium	3.12b-h	5.25a-k	9.13b-e	14.18 ab	25.13abc	47.67qrs	48.33 pqr
	Small	3.30a-g	5.93a-h	11.55ab	16.98a	28.59a	47.33 rs	47.67 qr
Cardinal	Large	2.38e-k	4.30h-l	5.99hij	10.28b-h	17.18d-h	65.47 bcd	65.33 def
	Medium	2.94b-i	5.22b-k	6.81d-j	11.79b-g	18.77c-h	64.00 de	65.33 def
	Small	3.61a-e	6.55a-e	8.29c-h	11.62b-h	20.21b-h	64.33 de	65.67 def
Courage	Large	2.51d-k	3.84i-l	5.03ij	7.52 gh	13.40gh	52.00klm	52.33lmn
	Medium	2.57c-k	4.35g-l	5.49hij	7.51 gh	15.74d-h	52.33 kl	52.67 lm
	Small	3.18a-g	6.05a-h	7.23d-j	9.89 b-h	17.92c-h	50.33mno	49.67 op
Diamant	Large	3.92ab	6.14a-g	7.56c-j	10.10b-h	17.08d-h	64.67de	65.67 def
	Medium	2.45e-k	4.61f-l	5.96hij	9.95 b-h	18.43c-h	63.00 e	64.67 ef
	Small	3.46a-f	6.08a-h	7.58c-j	10.81b-h	18.73c-h	64.00 de	64.33 f
Esprit	Large	2.91b-j	5.56a-i	7.14d-j	12.56a-f	16.71d-h	58.00 gh	57.67 k
	Medium	2.73b-j	4.78e-l	6.15f-j	9.29 b-h	18.87c-h	59.00 fg	57.67 k
	Small	2.34e-k	4.62f-l	7.55c-j	10.72b-h	19.11c-h	57.00 hi	58.00 jk
Felsina	Large	3.48a-f	6.73abc	9.11b-f	12.73a-f	19.38c-h	48.00 pqr	47.67 qr
	Medium	2.75b-j	4.99c-l	7.88c-i	10.56b-h	20.38b-h	46.33 s	47.33 r
	Small	2.85b-j	6.15a-g	13.16a	16.56 a	26.83ab	46.33 rs	48.00 qr
Granola	Large	2.79b-j	4.59f-l	5.45hij	6.79 h	13.02 h	68.00 a	68.00 ab
	Medium	2.05g-k	3.88i-l	4.84 j	6.97 gh	14.13fgh	67.67 a	68.67 a
	Small	3.05b-i	5.20b-k	6.27e-j	8.19 e-h	15.67e-h	67.33 ab	68.33 a
Lady Rosetta	Large	3.19a-g	5.27a-k	6.61e-j	9.047c-h	15.22e-h	66.67 abc	66.00 cde
	Medium	3.29a-g	5.53a-j	6.77e-j	9.563b-h	15.57e-h	65.87 a-d	67.33 abc
	Small	3.61a-e	6.89a	8.30c-h	10.84b-h	16.84d-h	66.33 abc	66.67 bcd
Provento	Large	3.78a-d	5.94a-h	7.04d-j	8.91 d-h	17.33d-h	59.67 fg	59.67 hi
	Medium	3.58a-e	5.85a-h	7.34c-j	9.57 b-h	17.39d-h	59.67 fg	60.00 hi
	Small	3.78a-d	6.60a-d	8.02c-i	10.46b-h	20.71b-h	59.00 fg	59.33 ij
Meridian	Large	2.97b-i	5.34a-j	8.26c-h	12.65a-f	19.42c-h	56.33 ij	56.67 k
	Medium	2.56c-k	4.58f-l	6.58e-j	11.06b-h	19.01c-h	56.33 ij	57.67 k
	Small	3.84abc	7.02a	9.03b-g	13.77a-d	22.16a-e	55.33 j	57.33 k
Quincy	Large	1.78ijk	3.75jkl	6.06hij	10.35b-h	15.39e-h	52.67 k	53.33 l
	Medium	1.79ijk	3.93i-l	5.82hij	9.560b-h	16.76d-h	52.67 k	53.67 l
	Small	2.65b-k	6.35a-f	9.72bcd	13.94abc	22.10a-e	52.33 kl	53.33 l

Table 3. Cont'd.

Sagitta	Large	1.39k	3.52kl	5.93hij	9.28 b-h	17.92c-h	49.67 no	52.67 lm
	Medium	1.40k	3.88i-l	5.69hij	9.62 b-h	18.01c-h	49.33 nop	51.33 mn
	Small	1.88h-k	5.04c-k	7.50c-j	11.69b-h	21.73a-f	49.00 pq	49.00 pq
Spunta	Large	1.64jk	3.23l	4.60 j	8.01fgh	16.33d-h	51.00 k-n	51.67 mn
	Medium	2.24f-k	4.66f-l	6.79e-j	9.88b-h	18.51c-h	50.67 l-o	51.00 no
	Small	2.22f-k	4.81d-l	7.22d-j	11.76b-g	23.38a-d	51.00 k-n	51.00 no
Omega	Large	2.10g-k	3.88i-l	5.42hij	8.82 e-h	14.97e-h	60.00 f	61.00 gh
	Medium	2.43e-k	4.33h-l	6.08g-j	9.60 b-h	15.28e-h	60.33 f	61.67 g
	Small	2.84b-j	4.99c-l	6.34e-j	9.98 b-h	15.29e-h	59.67 fg	61.00 gh
Mean		2.79	5.12	7.18	10.59	18.49	56.92	57.75
CV (%)		12.9	13.36	10.3	12.6	10.37	5.63	5.47

Means followed by same letter(s) in a column do not differ significantly at 1% level by DMRT

(66.67 days in large sized, 65.87 days in medium sized, and 66.33 days for small sized tubers). More or less similar performance of these two varieties was recorded in case of days to start shriveling. Overall poor performance of small tubers in case of days to sprout initiation and days to start shriveling was observed in all the varieties compared to that of other sizes.

Rotting loss in the varieties at different days after storage (DAS) varied (Table 4). Overall, it was observed that in most of the varieties, rotting loss was very low up to 60 DAS. From 60 DAS to 120 DAS, the rotting loss was higher in all the varieties and after 120 days of storage, rotting was comparatively low. However, performance of the variety BARI TPS-1 and Felsina was very poor regarding rotting, as total rotting loss (14.18% in BARI TPS-1 and 15.87% in Felsina) at 150 DAS was higher than that of all other varieties (Table 4). Total rotting loss at 150 DAS was lower in the variety Granola (4.55%). In all the varieties, rotting loss was below the mean value (7.63%) except BARI TPS-1 (14.18%), Felsina (15.87%), Provento (9.73%), Meridian (9.25%), Quincy (8.09%), and Sagitta (7.70%). This result was more or less in line with the findings of Azad *et al*. (2017). They reported in respect of rotting that significantly the highest degree was found in Felsina (18.72%) followed by that in Provento (15.01%) and the lowest was in Asterix (2.02%) and identically similar with Granola (2.22%).

While studying the rotting loss in different sizes of tubers, it was observed that rotting loss was higher in large sized tubers compared to that in other sized tubers (Table 5). Total loss at 150 DAS was 13.91% in large sized tubers followed by 5.85% in medium sized tubers and 3.14% in small sized tubers. Biswal and Dhal (2014) reported to have significantly higher rotting in large sized tubers compared to medium or small sized tubers at five months after storage in ambient condition. Finally, they concluded that the percent of rotting increased with increase in size of the tubers, which was in line with the present investigation. Although higher number of tubers rotten in small sized tubers but total rotting loss was lower as the tubers

Table 4. Rotting loss of different potato varieties under natural condition

Variety	Rotting loss (by % weight) at					Total rotting loss (by % weight) at 150 DAS
	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	
Asterix	0.00	0.00	1.40	2.96	1.29	5.65
BARI TPS-1	0.08	1.47	3.84	5.14	3.65	14.18
Cardinal	0.00	0.00	1.91	2.67	1.18	5.76
Courage	0.00	0.00	3.15	1.67	1.11	5.94
Diamant	0.00	0.00	1.79	1.95	1.38	5.11
Esprit	0.00	0.00	2.74	1.41	1.46	5.61
Felsina	0.41	5.31	5.44	2.85	1.86	15.87
Granola	0.00	0.00	0.45	2.08	2.02	4.55
Lady Rosetta	0.00	0.00	0.40	2.96	2.24	5.61
Provento	0.00	0.52	2.16	4.23	2.82	9.73
Meridian	0.00	0.00	2.38	3.71	3.16	9.25
Quincy	0.00	0.00	1.30	4.75	2.04	8.09
Sagitta	0.00	0.30	0.38	2.63	4.38	7.70
Spunta	0.00	0.21	2.48	2.41	0.95	6.05
Omega	0.00	0.07	1.65	2.14	1.57	5.42
Mean	0.03	0.53	2.10	2.90	2.07	7.63
CV(%)	32.57	26.25	19.54	18.21	15.67	12.65

Table 5. Rotting loss of different sizes of potato tubers under natural condition

Size	Rotting loss (by % weight) at					Total rotting loss (by % weight) at 150 DAS
	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	
Large	0.10	1.10	4.58	5.48	2.65	13.91
Medium	0.00	0.39	1.41	2.12	1.93	5.85
Small	0.00	0.08	0.31	1.11	1.65	3.14
Mean	0.03	0.53	2.10	2.90	2.07	7.63
CV(%)	32.57	26.25	19.54	18.21	15.67	12.65

were smaller in weight. Roy *et al.* (2006) also observed the minimum rotting in small sized tubers compared to that in medium and large sized tubers, which substantiated the findings of present investigation.

In BARI TPS-1, total rotting loss at 150 DAS in the large sized tubers was the highest (28.08%) and it was very close to that in Felsina (27.68%) with same sized tubers (Table6). Regardless of sizes, it was observed that rotting loss was very low in all the studied varieties except BARI TPS-1 and Felsina up to 60 days after storage and after that rotting loss increased. The highest average total loss was found at 120 DAS (2.90%). In the variety Felsina, more than 23% tubers were rotten in large sized tubers at 90 DAS and even 60 DAS, around 11.0% large sized tubers were rotten in Felsina (Table 6). Azad *et al*. (2017) also obtained the highest rotting loss in Felsina after 120 days of storage under ambient condition. This result again confirmed the inferiority of BARI TPS-1 and Felsina for storing under natural condition.

Table 6. Rotting loss of different potato varieties and sizes under natural condition

Variety	Size	Rotting loss (by % weight) at					Total rotting loss (by % weight) at 150 DAS
		30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	
Asterix	Large	0.00	0.00	3.68	6.84	1.10	11.62
	Medium	0.00	0.00	0.52	1.06	1.73	3.31
	Small	0.00	0.00	0.00	0.98	1.03	2.01
BARI TPS-1	Large	0.25	3.91	9.60	10.71	3.61	28.08
	Medium	0.00	0.50	1.61	3.35	4.12	9.58
	Small	0.00	0.00	0.32	1.35	3.22	4.89
Cardinal	Large	0.00	0.00	3.64	5.51	1.52	10.67
	Medium	0.00	0.00	1.24	1.40	1.20	3.84
	Small	0.00	0.00	0.84	1.10	0.82	2.76
Courage	Large	0.00	0.00	9.12	2.14	1.27	12.53
	Medium	0.00	0.00	0.33	1.84	1.12	3.29
	Small	0.00	0.00	0.01	1.04	0.95	2.00
Diamant	Large	0.00	0.00	2.12	3.39	2.50	8.01
	Medium	0.00	0.00	3.24	0.51	1.25	5.00
	Small	0.00	0.00	0.00	1.94	0.38	2.32
Esprit	Large	0.00	0.00	5.47	1.93	2.30	9.70
	Medium	0.00	0.00	2.40	1.80	0.98	5.18
	Small	0.00	0.00	0.34	0.50	1.10	1.94
Felsina	Large	1.24	9.64	12.50	2.50	1.80	27.68
	Medium	0.00	5.10	2.31	4.23	1.97	13.61
	Small	0.00	1.20	1.50	1.81	1.80	6.31
Granola	Large	0.00	0.00	1.35	3.22	3.45	8.02
	Medium	0.00	0.00	0.00	2.13	1.49	3.62
	Small	0.00	0.00	0.00	0.89	1.12	2.01
Lady Rosetta	Large	0.00	0.00	0.94	5.57	3.90	10.41
	Medium	0.00	0.00	0.26	2.08	1.46	3.80
	Small	0.00	0.00	0.00	1.24	1.37	2.61
Provento	Large	0.00	1.24	5.17	9.50	2.80	18.71
	Medium	0.00	0.31	0.81	2.54	3.80	7.46
	Small	0.00	0.00	0.50	0.66	1.85	3.01
Meridian	Large	0.00	0.00	3.18	8.52	5.58	17.28
	Medium	0.00	0.00	3.42	1.90	1.10	6.42
	Small	0.00	0.00	0.54	0.71	2.80	4.05
Quincy	Large	0.00	0.00	2.39	7.85	2.39	12.63
	Medium	0.00	0.00	1.52	5.06	2.15	8.73
	Small	0.00	0.00	0.00	1.34	1.58	2.92

Table 6. Cont'd.

Sagitta	Large	0.00	0.91	0.43	4.91	4.90	11.15
	Medium	0.00	0.00	0.53	1.81	5.10	7.44
	Small	0.00	0.00	0.19	1.16	3.15	4.50
Spunta	Large	0.00	0.62	4.98	5.06	1.24	11.90
	Medium	0.00	0.00	2.31	1.14	0.21	3.66
	Small	0.00	0.00	0.15	1.02	1.41	2.58
Omega	Large	0.00	0.21	4.10	4.62	1.40	10.33
	Medium	0.00	0.00	0.61	0.95	1.20	2.76
	Small	0.00	0.00	0.23	0.85	2.10	3.18
Mean		0.03	0.53	2.10	2.90	2.07	7.63
CV(%)		32.57	26.25	19.54	18.21	15.67	12.65

Conclusion

Storage performance was very good among the varieties like Granola, Diamant, Omega, Lady Rosetta, Espirit, Asterix, Cardinal, and Courage as they can be stored under natural storage with 5-6% rotting loss for 150 days. Whereas, rotting loss was the maximum (14.18% and 15.87%) in BARI TPS-1 and Felsina, respectively. On the other hand, medium sized (28-55 mm) potato is suitable for natural storage compared to small and large sized potatoes considering storage problem and market value.

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