J. Sylhet Agril. Univ. 4(1):95-100, 2017 ISSN: 2308-1597

ASSESSMENT OF WEIGHT LOSS OF ONION IN STORAGE DUE TO FUNGI

M Ahsanuzzaman[1], M M Sarker[1], R Hasan[2], A Muqit[3] and M A U Doullah*[3]

[1]*MS student, Department of Plant Pathology and Seed Science, Sylhet Agricultural University, Sylhet-3100*
[2]*Assistant Professor, Department of Plant Pathology and Seed Science, Sylhet Agricultural University, Sylhet-3100*
[3]*Professor, Department of Plant Pathology and Seed Science, Sylhet Agricultural University, Sylhet-3100*

(Available online at: www.jsau.com.bd)

Abstract

The experiment was conducted to assess weight loss of onion bulbs in storage due to fungi in the laboratory of the Department of Plant Pathology and Seed Science, Sylhet Agricultural University, Sylhet. A total of six onion entries where four Indian viz., Accession 1, Accession 2, Accession 3 and Pusa red, and two deshi viz. Faridpuri and Zitka were tested. The experiment was arranged in a Randomized Complete Block Design (RCBD) with three replications. Fungal disease development on stored onion bulbs was observed at 45 days of storage (DOS). Three important storage fungi namely *Aspergillus niger*, *Penicillium* spp. and *Fusarium oxysporum* were found to be predominant that caused black mould, blue mould and Fusarium bulb rot disease, respectively. All entries were found to be susceptible to the storage fungi. The lowest disease incidence was found in Zitka variety (10.34%) whereas the highest was in Pusa red (26.57%) variety. Black mould disease showed the highest disease incidence among the three diseases. Percent weight loss was recorded three times with 15 days interval of DOS. Weight losses of all entries were significantly different at 15 days of interval in storage condition. Pusa red variety showed the highest (35.7%) weight loss at 45 days of storage where the lowest (8.7%) was recorded in Zitka. All Indian entries showed higher weight loss compared to deshi entries. Significant and positive correlation was found (r = 0.885*) between disease incidence and weight loss.

***Keyword*:** *Allium cepa*, storage fungi, disease incidence, weight loss, onion.

Introduction

Onion (*Allium cepa* L.) is one of the most economically important and familiar vegetable as well as spice crops in the world. It ranks the top position in respect of area and production among condiments and spices grown in Bangladesh (BBS, 2009). The total production of onion in Bangladesh is about 10.51 lakh metric ton from an area of 1, 26,175 ha (BBS, 2013) while the estimated demand of onion in Bangladesh is about 15 lakh metric tons.

Onions are attacked by a number of diseases caused by various pathogens and cause production loss in the field (Ahmed and Hossain, 1985; Miah and Khan, 1987). Most of the diseases are caused by the fungi and among the fungal diseases, the most important and damaging ones are seed borne. Plant diseases specially seed borne (bulb borne) diseases are one of the most important cause for low yield all over the onion growing area. Richardson (1990) recorded 22 fungal pathogens in onion seeds where Fakir (1998) recorded 12 fungal pathogens in Bangladesh.

Under storage conditions, onion bulbs lose their weights due to continuous loss of water and dry matter. Mostly serious loss arises in store due to various bulb rotting microorganisms. The loss due to the storage disease is considerable but may go up to 40% (Ara, 2008). Considerable loss due to the disease resulting in failure of crop production is common. Recently, the storage diseases of onion are becoming an increasing threat to onion production.

The most destructive diseases in storage are black mould rot (*Aspergillus niger),* blue mould rot (*Penicillium* spp.), Fusarium bulb rot (*Fusarium* spp.), basal rot *(Fusarium moniliforme*), Aspergillus rot (*Aspergillus* spp.) etc. Among these diseases, mould disease is more severe in storage. *A. niger* and *Penicillium* spp. are the predominant fungal pathogens associated with storage disease of onion observed by Raju and Nail (2006). The disease incidence increased

***Corresponding author: M A U Doullah,** Department of Plant Pathology and Seed Science, Sylhet Agricultural University, Sylhet-3100, Bangladesh, Email: asadmeli@gmail.com*

with the increase in duration of storage irrespective of the temperature. *A. niger* and *A. flavus* infect bulbs at high temperature with high relative humidity while *Penicillium* spp. may destroy bulbs even at low temperature. Infections by *Penicillium* spp. may produce mycotoxin Penitrem A, which has been recently identified as cause of tremorgenic toxicosis in man and animals (Overy *et al*., 2005).

Few works have been done on storage fungi that cause serious loss in storage conditions. Moreover little information regarding the causes and loss of fungal deterioration of onion bulb in storage is not available under Bangladesh condition which is highly congenial to such disease and losses. Considering the above facts and circumstances, the present study was undertaken to assess the causes and losses in storage of onion bulbs especially by fungi and its relation to weight loss.

Materials and Methods

Experimental site

The experiments were carried out in the laboratory of Department of Plant Pathology and Seed Science, Sylhet Agricultural University, Sylhet during the period of July to November 2016.

Experiment materials

A total of six onion entries among which three were Indian entries namely Accession 1, Accession 2, Accession 3 and Pusa red, and two local namely Faridpuri and Zitka were used as experimental materials for the research work (Table 1). The test materials were collected from the Department of Crop Botany and Tea Production Technology, SAU, Sylhet and three different markets of Sylhet Sadar namely i. Mazortila market, ii. Modina market and iii. Subhanighat market.

Experiment period and storage procedure

The experiment was carried out during July to November 2016. Onion samples were stored on rack maintaining proper replications where room temperature throughout the period was between 25-30ºC.

Observation and identification of fungi

Disease development of stored onion bulbs was under close observation physically up to at 45 days of storage (DOS). After that each diseased onion sample was observed under a stereomicroscope at 10X and 25X magnifications in order to record the fungi. Most of the associated microorganism grown on the diseased onion was detected by their identifying characters as outlined by Barnett (1965). For confirmation of identification of fungi, temporary slides were prepared from the diseased bulb and observed under a compound microscope and identified with the help of keys suggested by Booth (1971) and Ellis (1971). Disease incidence (%) and weight loss (%) were recorded at 15 days interval as follows:

$$\text{Disease incidence (\%)} = \frac{\text{No. of infected bulb}}{\text{Total no. of bulb assesssed}} \times 100$$

$$\text{Weight loss (\%)} = \frac{\text{Initial weight of bulb} - \text{Weight of bulb at observation after storage}}{\text{Initial weight of bulb}} \times 100$$

Experimental design and statistical analysis

The experiment was laid out in a Completely Randomized Design (CRD) with three replications. The rerecorded data on various parameters of the present study were statistically analyzed using R statistical package programme. The level of significance and analysis of variance along with the Least Significant Difference (LSD) were calculated according to Gomez and Gomez (1984). Mean Differences were compared by Duncan's Multiple Range Test (DMRT) and correlation was performed by Microsoft Office Excel.

Results and Discussion

Frequency and occurrence of disease in stored onion bulbs

Frequency and occurrence of disease in stored onion bulbs are presented in Table 1. Data was recorded at 45 days of storage. The fungal infected bulbs varied with respect to variety and sources of collection. In case of Faridpuri variety, 13 bulbs was infected out of 84 collected from Majortila market, 11 out of 80 of Modina market and 12 out of 82 of Sobanighat bazar market were infected. On an average 14.63% fungal infected bulbs were found in Faridpuri variety collected from three markets of Sylhet Sadar.

In case of Zitka variety, 8 bulbs was found infected out of 89 collected from Majortila market, 11 out of 85 of Modina market and 8 out of 87 of Subhanighat market were found to be infected. On an average 10.34% bulbs were found to be fungal infected in Zitka variety.

Pusa red showed an average of 26.55% fungal infected bulbs whereas 28.3%, 25.00% and 26.55% infection were found in the onion bulb collected from Majortila, Modina and Subhanighat market, respectively.

In case of Accession 1, 49 bulbs were infected by the fungi out of 198 bulbs where 24.75% disease incidence was calculated at 45 days of storage. Besides, 57 bulbs were infected out of 235 bulbs in Accession 2 and 24.26% disease incidence was found. On the other hand, 55 bulbs were infected out of 226 in Accession 3 showing 24.34% disease incidence (Table 2).

From the study, it was revealed that all the varieties are susceptible to the storage fungi. The average disease incidence was higher in Pusa red variety followed by Accession 1, Accession 2 and Accession 3. The higher infection in Indian varieties may be due to higher injury in the bulb during transportation through long route, changed environment and/or larger size with more succulent. Beside, Zitka had shown the lowest fungal infection in storage because of smaller in size with strong skin. This result was supported by the result of Mahmud and Monjil (2015). They reported that fungal diseases in storage were higher in larger sized onion bulbs than indigenous small sized onion bulbs. Dry skin usually has good storability (Ko-SweeSuak *et al*., 2002). The present result is supported by the result of Ara (2008) where she found that Zitka showed the lowest disease infection in her survey work at storage condition.

Table 1. Name of the onion entries, sample size, source of collection and occurrence of disease in storage condition

Onion entries	Source*	Total onion bulb	Infected onion bulb	Disease incidence (%)
Faridpuri Variety	Maj	84	13	15.48
	Mod	80	11	13.75
	Sub	82	12	14.63
	Sub-total	*246*	*36*	*14.63*
Zitka Variety	Maj	89	8	8.99
	Mod	85	11	12.94
	Sub	87	8	9.20
	Sub-total	*261*	*27*	*10.34*
Pusa Red	Maj	60	17	28.33
	Mod	56	14	25.00
	Sub	61	16	26.52
	Sub-total	*177*	*47*	*26.55*
Accession 1	SAU	198	49	24.75
Accession 2	SAU	235	57	24.26
Accession 3	SAU	226	55	24.34
	Total	**1,343**	**271**	**20.18**

* Maj-Majortila market, Mod-Modina market, Sub-Subhanighat market, SAU-Sylhet Agricultural University, Sylhet

Percent disease incidence of different entries of stored onion bulbs

Disease incidence caused by storage fungi on different stored onion bulbs are presented in Table 2 and Fig1. The disease was recorded at 45 days of storage. There was significant difference in disease development in stored bulb among the entries (Figs.1a-c). All the entries produced three important storage diseases which were black mould caused by *Aspergillus niger*, blue mould caused by *Penicillium* spp. and Fusarium bulb rot caused by *Fusarium oxysporum*(Fig.1 and Table 2).

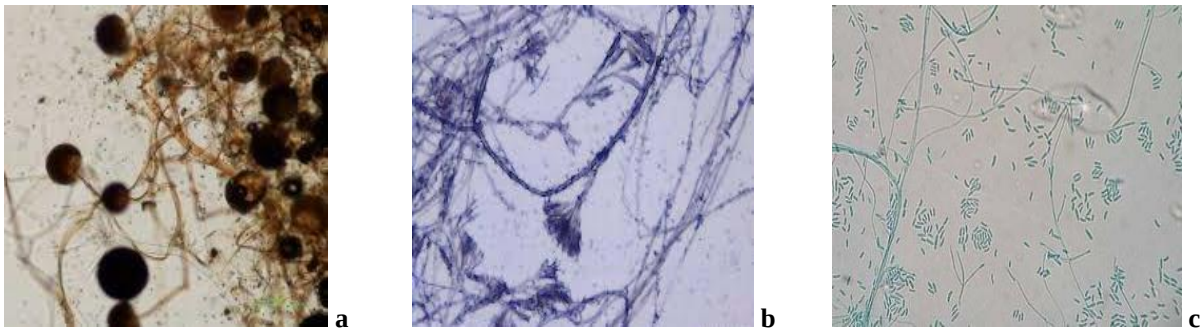

Fig. 1. Occurrence of storage fungi in onion entries a) *Aspergillus niger* b) *Penicillium* spp. c) *Fusarium oxysporum*

In case of Faridpuri variety, disease incidences were 27.7%, 8.3% and 6.0% in black mold, blue mould, respectively and rest were Fusarium bulb rot disease. Zitka variety showed 57.4%, 25.7% and 18.4% in black mould, blue mould and Fusarium bulb rot, respectively where in Pusa red, 47.0%, 18.1% and 32.5% were observed (Table 2). On the other hand, Accession 1 found to be infected with 47.0% black mould, 18.1% blue mould and 32.5% Fusarium bulb rot disease. Accession 2 expressed 37.9% black mould, 22.8 % blue mould and 38.1% Fusarium bulb rot disease in storage condition where Accession 3 showed 49.1%, 19.6% and 27.4% disease incidence, respectively. However, all Indian entries did not show any other diseases except the three diseases. The lowest disease incidence was found in Zitka variety (10.34%) where the highest was in Pusa red (26.57%) variety (Fig1). Black mould disease showed the highest disease incidence among the three diseases. All Indian entries showed the similar trend for disease development (Table 2). This result is supported by the result of Ara (2008). She found highest disease incidence in Pusa red variety at storage condition. That indicated that Pusa red is more susceptible to the storage fungi and is not suitable for long time storage. Satish *et al*. (2002) reported that major storage losses of onion bulbs are due to the storage diseases along with sprouting (Tariq *et al*., 2005).

Table 2. Incidence of three storage diseases on onion bulbs in storage conditions

Onion entries	Disease incidence (%)		
	Black mould	Blue mould	Fusarium bulb rot
Faridpuri	27.7 d (4.06)	8.3 c (1.22)	6.0 d (0.81)
Zitka	57.4 a (15.24)	25.7 a (6.78)	18.4 c (4.52)
Pusa Red	47.0 b (11.11)	18.1 b (3.53)	32.5 ab (8.08)
Accession 1	47.0 b (11.11)	18.1 b (3.53)	32.5 ab (8.08)
Accession 2	37.9 c (9.36)	22.8 ab (5.53)	38.1 a (8.94)
Accession 3	49.1 b (11.95)	19.6 ab (3.10)	27.4 bc (7.52)
LSD	4.85	6.94	10.23
CV (%)	7.002	23.696	27.267

Note: Disease incidence (%) determined from total onion bulbs is shown in parenthesis.

Weight loss of different entries of stored onion bulbs

Weight loss was measured at three different days of storage (Table 3). A total of 1343 onions bulbs belonging to six different entries were considered for this purpose. The weight losses were recorded 15, 30 and 45 days of storage (DOS) with 15 days interval where the storage temperature was between 25-30ºC. Significant difference was found regarding weight loss among the entries tested.

In case of Faridpuri variety 4.5% weight loss was found at 15 days of storage which was increased up to 16.7% at 45 days. At 30 days of storage weight loss was 10.7%. In Zitka variety, 1.4% loss was found at 15 days of storage and 4.6% and 8.7% at 30 days and 45 days of storage, respectively. In case of Pusa red, 16.7% weight loss was observed at 15 days, 25.7% at 30 days and 35.7% at 45 days of storage. Accession 1 showed 11.7%, 21.8% and 25.2% at 15, 30 and 45 days of storage, respectively. In case of Accession 2 it was 7.7%, 18.1% and 21.3% at 15, 30 and 45 days of storage, respectively where Accession 3 showed 12.5%, 23.45 and 30.2% at 15, 30 and 45 days of storage, respectively. All entries found to be differ significantly regarding weight loss at 15 days of interval in storage condition. Pusa red variety found to be the highest (35.7%) weight loss at 45 days of storage where the lowest (8.7%) weight loss was recorded in Zitka variety. This result was similar with the result of Ara (2008). She reported that percentage of storage loss in one week observation revealed the maximum storage loss in Pusa red variety and lowest in Zitka variety.

Table 3. Percent weight loss of different entries at fifteen days of interval at storage condition

Entries	Weight loss (%)		
	15 DOS	30 DOS	45 DOS
Faridpuri	4.5 d	10.7 d	16.7 d
Zitka	1.4 d	4.6 e	8.7 e
Pusa red	16.7 a	25.7 a	35.7 a
Accession 1	11.7 b	21.8 b	25.2 c
Accession 2	7.7 c	18.1 c	21.3 c
Accession 3	12.5 b	23.4 ab	30.2 b
LSD	3.16	3.92	3.27
CV (%)	19.596	9.333	10.584

All entries showed higher weight loss compared to local varieties. A correlation analysis was made between disease incidence and weight loss during storage condition after 45 days of storage and found a significant correlation (r = 0.885*) (Fig. 2). From the study it was observed that the higher the infection the higher is the weight loss. The results are in agreement with the results of Satish *et al*. (2002) who reported that storage losses were significantly influenced by storage diseases.

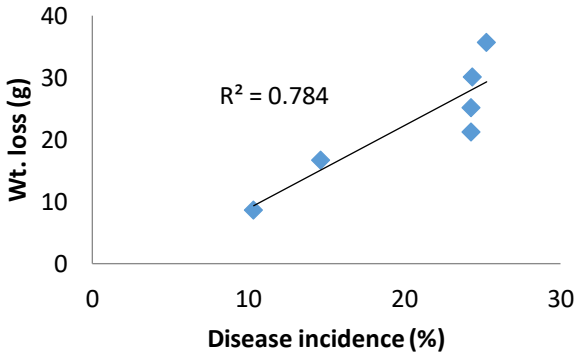

Fig. 2. Correlation between disease incidence and weight loss of six onion entries at 45 days of storage

Conclusion

Storage fungi are the major problem of onion bulb that causes serious loss in store. Three most important storage diseases were recorded at storage condition in the present study. These were black mould (*Aspergillus niger*), blue mould (*Penicillium* spp.) and Fusarium bulb rot (*Fusarium oxysporum.*). All six entries were susceptible to the storage fungi where black mould disease caused by *Aspergillus niger* was predominant. The lowest disease incidence was recorded in Zitka variety and the highest disease incidence was in Pusa red variety. The highest infection and weight loss was recorded in Pusa red variety where Zitka showed the lowest. Based on the result Zitka variety has more durability in storage condition as because of its less fungal infection and less weight loss ability.

References

Ahmed H U and Hussain M M. 1985. Final report of the project crop disease survey and establishment of a herbarium at Bangladesh Agricultural research Institute, Plant Pathology Division, Bangladesh Agricultural research Institute, Jaydebpur, Gazipur. 170 pp.

Ara, A M, Doullah M A and Ashrafuzzaman M. 2008. Isolation and identification of storage fungi from onion. Int. J. Sustain. Crop Prod. 9(3):41-46.

Barnett H L. 1965. Illustrated genera of imperfect fungi. Burgress Publishing Co. 225 pp.

BBS (Bangladesh Bureau of Statistics). 2009. Statistical Yearbook of Bangladesh, Planning Division, Dhaka, Ministry of Planning, Government of Peoples Republic of Bangladesh. 52 pp.

BBS (Bangladesh Bureau of Statistics). 2013. Statistical Pocketbook of Bangladesh, Planning Division, Dhaka, Ministry of Planning, Government of Peoples Republic of Bangladesh. 49 pp.

Booth C. 1971. The *Fusarium* commonwealth Mycol. Inst. Kew, Survey, England. 236 pp.

Ellis M B. 1971. Dematiaceous Hypomycetes. CMI, Kew survey, English. 507 pp.

Fakir G A. 1999. An annotated list of seed-borne pathogen. Seed Pathology Laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh. 145 pp.

Gomez K A and Gomez A A. 1984. Statistical procedure for agricultural research. 2nd End. Intl. Res. Inst. Manila, Phillipines. 139-207.

Ko-Sweesuak S, Chang W N, Wang J F, Cherng S J and Shanmugasundaram S. 2002. Storage variability among short day onion cultivars under high temperature and high moisture conditions. Hort. Sci., 127(5): 848-854.

Mahmud M S and Monjil M S. 2015. Storage disease of onion under variable conditions, Progressive Agriculture Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh. 26:45-50.

Meah M B. and Khan A A. 1987. Check list of fruit and vegetable disease in Bangladesh. Department Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh. 23 pp.

Raju K and Nail M K. 2006. Effect of pre- harvest spray of fungicides and botanicals on storage of onion. Indian Phytopath. 59(2): 133-141.

Richardson M J. 1990. An annotated list of seed-borne diseases, International Seed Health Testing Handbook and Commonwealth Mycological Institute. Commonwealth Agri. Bureaux. 23 pp.

Satish S V, Ranganna V and Ramakumar M V. 2002. Influence of storage condition on onion losses in ambient storage. Mysore J. Agri. Sci. 36(3): 260-265.

Tariq M A. and Mazullah B. 2005. Assessment of post harvest losses of onion bulb during storage at room condition. Shahad J. Agri. 21(2): 189-191.