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Response of gamma irradiation on post harvest losses in some onion varieties

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ABSTRACT

The post harvest treatments such as gamma-irradiation are known to reduce sprouting in onion. An, experiment was taken up to study the effect of gamma irradiation in dark red, light red , white and yellow colour onion varieties. The well-cured bulbs of 17 onion varieties were treated with 60 Gy dose of gamma rays and stored at ambient temperature from May to September. The observations on different types of losses were recorded at 15 day interval. The result revealed that gamma irradiation effectively checked sprouting in all onion varieties irrespective of their colour. There was no sprouting in irradiated bulbs of all varieties, while it was 0.0 to 34.3 percent in un-irradiated onions. There was no significant effect on physiological loss of weight, rotting and black mould infection. The total storage losses in irradiated onion were significantly less than unirradiated onion. The total losses in light red and yellow colour varieties were lower than dark red and white varieties.

Key words: Onion varieties, gamma irradiation, storage losses.

INTRODUCTION

Onion is an important export oriented vegetable crop of our country. It is grown in 0.76 million hectare area with a production 13.5 million tonnes per year. The major crop (about 60%) is harvested during April and May months. A large quantity of onion is stored for 4 to 5 months to fulfill the demand from June to October. The storage of onion in India is done under ambient conditions, where there is no control over humidity and temperature and storage losses are very high due to high temperature and humidity during the storage period. Various types of storage losses are physiological weight loss, rotting and sprouting. These all together damage 50% onion during 4 to 5 months of storage. The storability of onion is influenced by several factors such as vareital difference, season, cultural practices, pre and post harvest treatments, storage environment (Brice *et al.*, 2; Martinez *et al.*, 5; Shinde *et al.*, 9). The vareital difference or the genetic make up of the variety play important role in the storage life of onion. The bulb colour, number of scales, total soluble content etc. affects the storability of onion (Brice *et al.*, *2*). The post harvest treatment of gamma irradiation found successful in reducing storage losses in onion. The radiation of onion at 60-90 Gy has been reported to reduce sprouting. The irradiated onion bulbs were judged to be superior in quality with respect to internal and external appearance and firmness after 180 days storage than non-irradiated ones (Curzio, 3). The storage losses were lower when the un-irradiated and irradiated bulbs were kept either at ambient or low temperature (Tripathi and Lawande, 10). Thus, an experiment was undertaken to study the effect of gamma irradiation (60 Gy dose from cobalt-60 source) on post harvest losses in different colour onion varieties.

MATERIALS AND METHODS

The experiment was carried out at National Research Centre for Onion and Garlic, Rajgurunagar (Pune) during 2004 and 2005. Seventeen onion varieties i.e., Arka Pragati, Agrifound Dark Red (ADR), Arka Kalyan, Baswant-780, N-53 (Dark Red), Pusa Madhavi, N-2-4-1, Pusa Red, Agrifound Light Red (ALR), GWO-1, PKV White, Pusa White Round, Udaipur-102, Phule Sufed, JNDWO-85 (white), Phule Suwarna, and Arka Pitambar (yellow) were taken for the study. The onions of these varieties were harvested in the month of April and kept for shade curing for fifteen days. Half of these onions were treated with 60 Gy gamma rays at Food Technology Division, Bhabha Atomic Research Centre, Mumbai. The un-irradiated and irradiated onions were stored at ambient (atmospheric) conditions in bottom ventilated storage structure for four months from May to October. The mean highest temperature of the storage structure ranged from 30°C in December to 39°C in May. The mean lowest temperature was 18°C in December to 25°C in June. The maximum humidity was ranging from 55% in March to 95% in August, while minimum relative humidity was ranging from 20 per cent in December to 90% in August. The storage losses such as rotting, sprouting, physiological loss in weight and

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black mould were recorded on fresh weight basis at 15 day interval for 4 months. The physiological weight loss was calculated by reducing rotting and sprouting from total losses. The two years data were analyzed by the method described by Panse and Sukhatme (7).

RESULTS AND DISCUSSION

The physiological loss of weight (PLW) was highest in red colour varieties from beginning and it was higher (18.78%) than other colour varieties after 120 days of storage. The lowest physiological loss of weight was recorded in light red colour varieties (14.43%). The weight losses in white and yellow colour varieties were 17.90% and 16.85% respectively. The highest PLW was recorded in white colour cv. Pusa White Round which were 21.3% while lowest PLW was recorded in light colour cv. N-2-4-1 (Fig. 1 a&b). The higher losses in dark red colour varieties may be correlated with the short dormancy and low soluble solids (Brice *et al*., 2). The short dormancy may lead to early breakage of complex compounds into simple compounds for the vegetative growth.

There was no significant difference in the rotting percentage in different colour varieties. Some of the varieties namely Arka Pragati, Arka Kalyan, Pusa Madhavi, PKV White, showed higher rotting than other varieties. There was no significant difference in the different colour varieties but there were some varieties, which showed higher rotting (Fig. 2 a&b). The reason may be that rotting of the bulbs is more related with the storage temperature and humidity and the pathogen loads in the bulbs at the time of storage.

There was significant difference in the sprouting in the unirradiated bulbs of different varieties. The lowest sprouting was recorded in light red colour varieties (5.68%) after 120 days of storage. The highest sprouting (30.57%) was recorded in dark colour varieties and followed by yellow varieties (18.33%) and white varieties (15.70%). Among different varieties, highest sprouting was recorded in Agrifound Dark Red (39.04%) followed by B-780 and N-53 (35.2%), while lowest sprouting was recorded in N-4-2-1 (0%), Pusa Red (6.6%), Udaipur-102 (8.4%) (Table 1). The sprouting in different colour onion varieties is more associated with the internal physiological status of the bulbs than the colour of the bulbs. The colour of skin seems to be lesser associated with sprouting (Martinez *et al*., 5).

There was no black mould infection in the initial two months. The black mould infection increase increased after two months of storage. This increase coincided with the high relative humidity period. The higher storage humidity virtually triggered the infection of the black mould causing pathogen *Aspergillus* (Table 2). Significantly higher black mould infection was recorded in white colour varieties (14.43%) as compared to 10.60% in yellow colour onion varieties, 9.40% dark red colour varieties and 6.5% in light red colour varieties (Table 2). The higher black mould infection in colour varieties may be associated with the phenolic compounds, protein and total soluble solids (Martinez *et al*., 5).

Higher total storage losses (69.41%) were recorded in dark red colour varieties after 120 days of storage while lowest losses were found in light red colour varieties (47.88%). Among all the varieties lowest losses were recorded in cv. N-2-4-1, which were 35.4%. The higher total losses in dark red colour varieties because of higher weight loss and sprouting (Fig. 3 a&b). The lower storage in light red colour varieties may be attributed to the longer dormancy period, more number of outer scales etc. The lower losses in light red colour varieties have been reported by Martinez *et al.* (5) and Rafika *et al.* (8).

The physiological loss of weight (PLW) was 14.61% in irradiated onion as compared to 16.85% in unirradiated onions after 4 months of storage. Gamma-irradiation was found effective in reduction of PLW in some dark red colour varieties but it was non significant. Among the various varieties gamma radiation was found most effective in reduction PLW in dark red colour cvs. Agrifound Dark Red, B-780 and N-53 (Fig. 1 a&b). This effect may be due to the prevention of internal sprouting, which contributes major loss in dark red colour varieties by virtue of short or no dormancy. The lower weight loss in irradiated onion bulbs was also reported by Curzio (3).

The gamma irradiation reduces rotting losses in most of the varieties irrespective of colour but it was not significant. Insignificant increase was also noticed in some of the varieties. The reduction of rotting was noticed in two yellow colour varieties (Fig. 2 a&b). It seems that there are other factors such as the presence of pathogens in the bulbs and the storage temperature and humidity, which influence rotting of bulbs more than irradiation. It has been reported that the lower doses (< 1 kGy) of gamma irradiation has almost negligible effect on reduction of pathogenic microorganisms (Anon, 1).

Gamma irradiation was found effective in preventing the sprouting losses in all onion varieties irrespective of colour. There was no sprouting in the irradiated onion of all these varieties even after 120 days of storage as against 18.33% in unirradiated onions (Table 1). The results of irradiation in reduction in storage losses and inhibition of sprouting are in accordance with the findings of Iglesias-Enriquez *et al*. (4) and Curzio (3).

There was no effect of gamma irradiation on the black mould infection in different colour onion varieties (Table 2). It indicates that there was no effect of low

Table 1. Effect of irradiation on sprouting losses in onion varieties.

Variety	Sprouting (%) days after storage														
	30			45		60		75		90		105		120	
	IR	UNIR	IR	UNIR	IR	UNIR	IR	UNIR	IR	UNIR	IR	UNIR	IR	UNIR	IR
Red colour															
Arka Pragati	0	0	0	0	0	4.0	0	11.4	0	11.4	0	17.4	0	17.4	0
ADR	0	7.4	0	15.6	0	18.44	0	22.44	0	28.04	0	32.84	0	39.04	0
Arka Kalyan	0	0	0	1.2	0	7.6	0	14.4	0	18.0	0	20.6	0	21.8	0
Baswant -780	0	3.2	0	4.6	0	13	0	27.8	0	33.4	0	35.6	0	38.4	0
N-53	0	2.2	0	6.2	0	12.3	0	22.8	0	28.4	0	33.2	0	35.2	0
Average	0	2.56	0	5.52	0	11.07	0	19.77	0	23.85	0	27.93	0	30.37	0
Light red colour															
Pusa Madhavi	0	0	0	0	0	2.8	0	8.4	0	8.4	0	11.0	0	11.0	0
N-2-4-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pusa Red	0	0	0	0	0	1.8	0	1.8	0	1.8	0	1.8	0	6.6	0
ALR	0	0	0	0	0	2.4	0	2.4	0	2.4	0	8.2	0	10.8	0
Average	0	0	0	0.0	0	1.40	0	2.52	0	2.52	0	4.20	0	5.68	0
White colour															
GWO-1	0	0	0	1.4	0	6.6	0	10.0	0	14.8	0	17.6	0	17.6	0
PKV White	0	0	0	1.4	0	4.2	0	7.4	0	10.0	0	14.0	0	16.4	0
Pusa White Round	0	0	0	0	0	7.4	0	10.0	0	10.0	0	10.0	0	10.0	0
Udaipur 102	0	0	0	0	0	0	0	0	0	5.0	0	8.4	0	8.4	0
Phule Sufed	0	0	0	3.6	0	14.6	0	24.2	0	26.0	0	27.0	0	27.8	0
JNDWO-85	0	0	0	0	0	0	0	4.4	0	4.4	0	9.2	0	14.0	0
Average	0	0	0	1.07	0	5.47	0	9.33	0	11.70	0	14.37	0	15.70	0
Yellow colour															
Phule Suwarna	0	2	0	3.4	0	4.6	0	10.8	0	13.4	0	14.4	0	16.0	0
Arka Pitambar	0	1.4	0	1.4	0	6.0	0	8.8	0	8.8	0	20.4	0	21.2	0
Average	0	1.70	0	2.40	0	5.30	0	9.80	0	11.10	0	17.40	0	18.60	0
$CD_{(0.05)}$ IR		-		0.49		1.1		2.14		4.39		5.81		7.93	
Var.		-		0.50		1.21		2.37		4.79		6.22		8.93	
I x V		-		2.17		5.97		7.88		9.11		11.32		13.34	

dose of gamma irradiation on the decontamination of *Aspergillus* and other fungi. The ineffectiveness of lower doses (< 1 kGy) of gamma radiation in control of disease causing pathogens have been reported in the past (Anon, 1).

Gamma irradiation significantly reduced total storage losses in all the varieties. The effect of gamma radiation in reduction of losses was more in dark red colour varieties (30%) as compared to 23% in yellow colour and 13% in light red colour varieties which can be correlated with the dormancy period of these varieties. The red colour varieties have shorter dormancy than light red colour varieties and the prevention of internal dormancy in red colour varieties resulted in reduction of losses. Over all, gamma irradiation reduced 23% storage losses in all the cultivars after 120 days of storage (Fig. 3 a&b). Similar effect of gamma radiation in onion where the storage losses were reduced by 15 to 30 percent as compared to un-irradiated bulbs after 4 to 6 months of storage (Enriquez *et al.*, 4) .

Table 2. Effect of irradiation on black mould in onion varieties.

Variety	Black mould infection (%) days after storage									
	60		75		90		105		120	
	UNIR	IR	UNIR	IR	UNIR	IR	UNIR	IR	UNIR	IR
Red colour										
Arka Pragati	0	0	2.0	2.4	5.6	7.8	5.6	12.4	8.2	12.4
ADR	0	0	2.6	2.4	6.4	5.8	6.4	9.0	6.4	9
Arka Kalyan	0	4.6	0	4.6	0	7.4	1.8	7.4	4.8	7.4
Baswant -780	0	8.0	0	2.0	0	2.0	0	5.0	0	8.0
N-53	0	6.0	2.2	6.0	5.4	6.0	5.4	10.2	6.2	10.2
Average	0	3.72	1.36	3.48	3.48	5.80	3.84	8.80	5.12	9.40
Light red colour										
Pusa Madhavi	0	3.4	0	3.4	0	3.4	0	8.4	1.2	8.4
N-2-4-1	0	1.8	0	1.8	0	5.2	3.4	5.2	6.6	5.2
Pusa Red	0	0	1.6	2.4	4.2	5.4	4.2	7.2	4.2	7.2
ALR	0	0	0	0	0	0	3.8	5.2	7.2	5.2
Average	0	1.30	0.40	1.90	1.05	3.50	2.85	6.50	4.80	6.50
White colour										
GWO-1	0	0	8.4	4.2	14.4	9.2	14.4	14.0	18	17.4
PKV White	0	4.2	6.6	4.6	12.2	10.4	12.2	10.4	12.2	11.6
Pusa White Round	0	0	4.4	9.8	8.6	13.6	11.0	18.4	15.2	18.4
Udaipur 102	0	0	4.0	5.0	9.0	6.6	11.8	9.0	15	11.0
Phule Sufed	0	2.4	3.6	3.3	7.8	7.04	7.8	8.24	8.6	11.64
JNDWO-85	0	0	4.2	5.6	9.2	12.2	12.8	14.6	17.6	19.0
Average	0	1.10	5.20	5.42	10.20	9.84	11.67	12.44	14.43	14.84
Yellow										
Phule Suwarna	0	0	0	0	0	0	2.6	4.4	6.0	4.8
Arka Pitambar	0	3.2	0	6.4	0	10.6	7.4	16.4	8.6	16.4
Average	0	1.60	0.	3.20	0.	5.30	5.00	10.40	7.30	10.60
$CD_{(0.05)}$ IR	-		-		NS		NS		NS	
Var.	-		-		3.75		4.72		6.73	
I x V	-		-		7.39		9.52		11.4	

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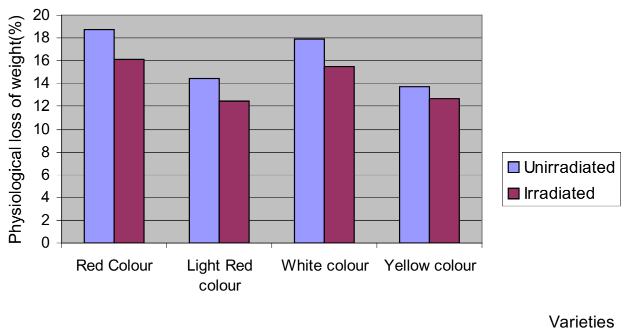

Fig. 1a. PLW(%) in unirradiated and irradiated onions of different coloured varieties after 120 days of storage.

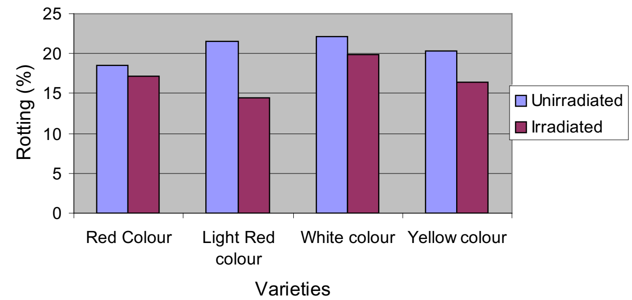

Fig. 2a. Rotting in unirradiated and irradiated in different coloured varieties of onion.

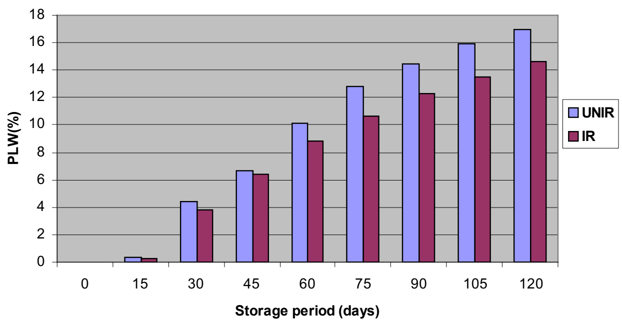

Fig. 1b. Physiological weight loss (PLW) in irradiated and unirradiated onions.

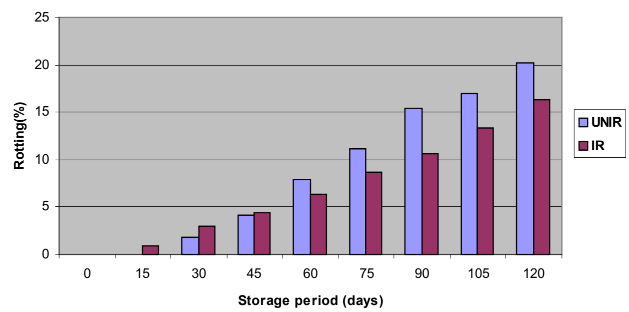

Fig. 2b. Rotting losses in irradiated and unirradiated onion.

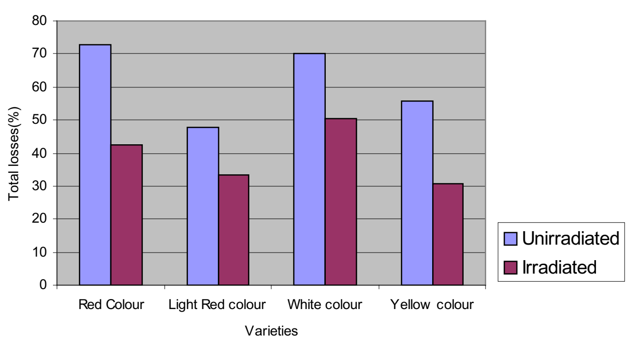

Fig. 3a. Total storage losses in unirradated and irradiated onion of different coloured varieties after 120 days of storage.

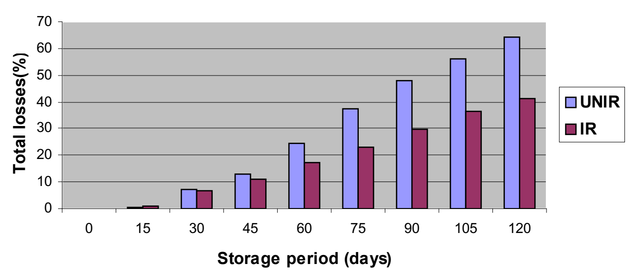

Fig. 3b. Total storage losses in irradiated and unirradiated onions at periodic intervals.

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