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Temperature Treatments on Postharvest Handling of Small Onion (*Allium cepa* L. var. *aggregatum* Don.)

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Studies on the effect of different temperature treatments on packing and storage methods in onion (*Allium cepa* L. var. *aggregatum* Don.) cv. CO On 5 at College orchard, Tamil Nadu Agricultural University, Coimbatore were temperature during 2008-2010. The experiment was laid out in a factorial completely randomized design (FCRD) with eight treatments and three replications. Pre-harvest sprays were done by using Maleic hydrazide @ 2000ppm + carbendazim @ 1000ppm and the harvested onion bulbs were cured with 2cm neck length packing and storage treatments were subjected to viz., jute bags and kept in room temperature (T_1), packing in nylon net bags and kept in room temperature (T_2), packing in perforated plastic crates and kept in room temperature (T_3), packing in bamboo baskets and kept in room temperature (T_4), spreading of bulbs in ventilation storage (T_5), spreading of bulbs in cold storage at 15°C (T_6), spreading of bulbs in cold storage at 20°C (T_7) and spreading of bulbs in room temperature - Control (T_8). Among the different packing and storage treatments, the lowest physiological loss in weight (5.18 %), sprouting (0.62 %), rotting (0.64 %), rooting (0.00 %) and the highest sulphur (0.704 %), pyruvic acid (2.53 µmol g^{-1}) and ascorbic acid (10.24 mg 100 g^{-1}) contents and the highest shelf life (up to 6 months) were observed in spreading of bulbs in ventilation storage (T_5) compared to control (T_8).

Key words: Onion, packing, storage, temperature.

Onion is one of the potential foreign exchange earners and is one among the vegetables, where India figures prominently in the world's export market. India stands first in production, sharing eight per cent of the world production (Anon., 2008). The *aggregatum* onion cv. CO On 5 has got better market preference because of its size and appealing attractive pink colour. Presently about 35 to 40 per cent of the onion is estimated to be lost during post-harvest handling. In general, the losses due to reduction in weight, sprouting and rotting (decay) were found to be 20 to 25, 4 to 5 and 10 to 12 per cent respectively (Pandey, 1989; Anon., 1994). The bulb respires and transpires continuously resulting in high weight loss and becomes susceptible to various diseases and spoilage due to inappropriate packaging. One of the major problems confronted by small onion growers adequate and proper packaging protects the bulb from physical (firmness), physiological (weight) and pathological (decay) deterioration.

Provision of proper storage structures or of suitable field techniques coupled with storage temperature plays a major role in postharvest life and quality of onion. With this background, the present investigation was carried out to standardize the appropriate packing and storage techniques and storage temperature for enhancing quality and shelf life of onion cv. CO (On) 5.

Materials and Methods

The present investigations were carried out at the College Orchard, Tamil Nadu Agricultural University, Coimbatore during 2008- 2010 storage period met data furnished in table 1). In addition to regular cultivation practices, maleic hydrazide @ 2000ppm + carbendazim @1000ppm at 30 days before harvest were sprayed and the bulbs harvested with 2cm neck length were used curing with, a composite sample of five kg bulbs packed in different packing materials *viz*., 40kg capacity open mesh jute bags weighing 250g, 40kg capacity open mesh nylon net bags weighing 60g, baskets made up with split bamboo sticks (20 x 15 x 25cm) of 5kg capacity, perforated plastic crates (50 x 30 x 28cm) of 15kg capacity. The bulbs were stored in two methods *i.e*., low cost ventilation storage {constructed as per the specifications given by Tripathi and Lawande, (2005)} and two different cold storage environments *viz*., 15$_0$C with 60 % RH and 20$_0$C with 80% RH. The details of the treatments were given below.

Design: Factorial completely randomized design (FCRO)

Factor A- Type of packing and storage (T)

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Factor B - Period of storage (P)

Factor A. Treatments

T_1 - Packing in jute bags and kept in room temperature

T_2 - Packing in nylon net bags and kept in room temperature

T_3 - Packing in perforated plastic crates and kept in room temperature

T_4 - Packing in bamboo baskets and kept in room temperature

T_5 - Spreading of bulbs in ventilation storage

T_6 - Spreading of bulbs in cold storage at 15°C/ 60%

T_7 - Spreading of bulbs in cold storage at 20°C/ 80%

T_8 - Spreading of bulbs in room temperature (Control)

Factor B - Period of storage (P)

P_1- 30 days after storage

P_2- 60 days after storage

P_3- 90 days after storage

Replications: Three

Initial observations were recorded before imposing treatments and the storage observations were recorded at 30, 60 and 90 days. (monthly intervals). The bio-chemical parameters *viz.,* ascorbic acid (AOAC, 1975), sulphur (Chopra and Kanwar, 2008) and pyruvic acid were studied. The physiological parameters *viz.,* physiological loss in weight (PLW), sprouting loss, rotting loss, rooting loss were also calculated as per the standard procedures.

The rooted bulbs from the storage room were taken out, and rooting loss was worked out accordingly.

$$\text{Rooting loss (\%)} = \frac{\text{Weight of the rooted bulbs (g)}}{\text{Initial weight of the bulbs (g)}} \times 100$$

The data obtained from the present investigations were subjected to statistical scrutiny (Panse and Sukhatme, 1985).

Results and Discussion

Onion bulbs in storage generally undergo loss in weight owing to physiological changes like sprouting, rooting, rotting, desiccation, nutritional and other bio-chemical changes.

Physiological changes

Physiological loss in weight, rotting and rooting was increased during the storage period. Among the storage techniques, the lowest physiological loss in weight (5.18 per cent), sprouting (0.62 per cent), rotting (0.64 per cent) and rooting (0.00 per cent) was observed in T_5 (Spreading of bulbs in ventilation storage) . While, the least physiological loss in weight (6.76 per cent), rotting (0.04 per cent) and rooting (3.63 per cent) was recorded in P_1 (30 days after storage). As the storage period increased from 30 to 90 days, sprouting also increased, except in cold storage treatments. In cold storage 90 per cent sprouting was obtained 30 days after storage.

Table 1. Weather condition during the storage period

Months	Open condition				Room condition			
	Temperature		Relative humidity (%)		Temperature		Relative humidity (%)	
	Max.(°C)	Min.(°C)	M07.22 hrs	E14.22 hrs	Max.(°C)	Min.(°C)	M07.22 hrs	E14.22 hrs
January	30.5	20.2	88	45	25.5	15.0	95	50
February	30.9	20.9	85	36	24.4	14.4	90	42
March	35.6	20.9	80	30	30.0	16.0	87	40
April	36.6	25.2	85	42	31.2	20.0	90	50

Source: Dept. of Agro Climate Research Centre (ACRC), Tamil Nadu Agricultural University, Coimbatore-3.

The least sprouting was registered in P_3 (90 days after storage) recording values of 1.50 per cent (Table 2 & 3).

Interaction between treatments and period of storage showed that, the minimum value of physiological loss in weight (2.72 per cent), sprouting (0.15 per cent), rotting (0.00 per cent) and rooting (0.00 per cent) was recorded in T_5P_1 (Spreading of bulbs in ventilation storage + 30 days after storage).

In the present study, weight loss in bulbs was found to increase with increase in the storage period. Palaniswamy (1980) and Vincent (1980) in small onion also observed a similar phenomenon in storage. In the present investigation, the bulbs stored in low cost bottom ventilated structure recorded lowest physiological loss in weight, which is in accordance with the findings of Kopec (1963). This might be due to proper aeration, causing decreased temperature and humidity level inside the structure.

The dormant buds enclosed in the fleshy scales start sprouting in and earlier the sprouting in storage, the more is the loss to growers as the sprouted bulbs have lesser weight than non-sprouted ones. In the present study, the effect of various treatments

Table 2.Effect of packing and storage methods on physiological loss in weight (%) and sprouting (%) content in onion

Treatment	Physiological loss in weight (%)				Sprouting (%)			
	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
T_1	5.33 (13.35)	7.53 (15.93)	13.75 (21.77)	8.87 (17.02)	0.27 (2.56)	0.83 (5.24)	1.30 (6.55)	0.80 (4.78)
T_2	4.00 (11.54)	5.72 (13.83)	11.83 (20.12)	7.18 (15.16)	0.25 (2.87)	0.75 (4.97)	1.23 (6.38)	0.74 (4.74)
T_3	3.55 (10.86)	4.67 (12.48)	10.52(18.91)	6.25 (14.08)	0.20 (2.56)	0.70 (4.80)	1.15 (6.16)	0.68 (4.51)
T_4	6.95 (15.29)	8.92 (17.37)	15.70 (23.34)	10.52 (18.67)	0.35 (3.39)	1.00 (5.74)	1.32(6.59)	0.89 (5.24)
T_5	2.72 (9.49)	3.00 (11.54)	9.83 (18.28)	5.18 (13.10)	0.15 (2.22)	0.55 (4.25)	1.15 (6.16)	0.62 (4.21)
T_6	11.98 (20.25)	13.87 (21.86)	21.10 (27.35)	15.65(23.15)	16.00 (23.58)	12.00 (20.27)	2.27 (8.59)	10.09 (17.48)
T_7	10.77 (19.16)	12.62 (20.98)	19.80 (26.42)	14.40 (22.19)	15.00(22.79)	10.00 (18.44)	2.17 (8.46)	9.06 (16.56)
T_8	8.78 (17.24)	10.78 (19.17)	17.47 (24.70)	12.34 (20.37)	0.50 (4.05)	1.10 (6.02)	1.40 (6.80)	1.00 (5.62)
Mean	6.76 (14.65)*	8.39 (16.65)	15.00 (22.61)	10.05 (17.97)	4.09 (8.00)	3.74 (8.72)	1.50 (6.96)	3.11 (7.89)
	T	P	T x P		T	P	T x P	
SEd	0.019	0.012	0.033		0.032	0.019	0.055	
CD (0.05)	0.038	0.023	0.065		0.063	0.038	0.109	

(*Values in parenthesis are arcsine transformed)

Treatment details

T_1- Packing in jute bags and kept in room temperature
T_2- Packing in nylon net bags and kept in room temperature
T_3 - Packing in perforated plastic crates and kept in room temperature
T_4 - Packing in bamboo basket and kept in room temperature
T_5 - Spreading of bulbs in ventilation storage
T_6 - Spreading of bulbs in cold storage at 15$_0$C
T_7- Spreading of bulbs in cold storage at 20^{0}C
T_8- Spreading of bulbs in room temperature Control)

P_1- 30 days after storage
P_2- 60 days after storage
P_3- 90 days after storage

on the sprouting of onion bulbs in storage revealed that the stored bulbs started sprouting only after a month and the bulbs kept under low cost bottom ventilated storage structure recorded less sprouting. and were in conformity with the findings of Singh and Dhankhar (1995) and Kukanoor *et al*. (2005).

Rotting of stored onion bulbs is normally due to the pathogens, *viz*., *Botrytis allii* and *Pseudomonas alliicola* causing neck rot and soft rot developed due to excess humidity. In the present investigation, bulbs stored in low cost bottom ventilated structure recorded reduced the rotting incidence. Probably

Table 3. Effect of packing and storage methods on rotting (%) and rooting (%) in onion

Treatment	Rotting (%)				Rooting (%)			
	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
T_1	0.00 (0.91)	0.99 (5.72)	1.48 (6.99)	0.82 (4.54)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)
T_2	0.00 (0.91)	0.96 (5.63)	1.35 (6.67)	0.77 (4.40)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)
T_3	0.00 (0.91)	0.90 (5.44)	1.33 (6.63)	0.74 (4.33)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)
T_4	0.00 (0.91)	1.03 (5.83)	1.72 (7.53)	0.92 (4.76)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)
T_5	0.00 (0.91)	0.85 (5.29)	1.08 (5.97)	0.64 (4.06)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)
T_6	0.12 (1.95)	1.12 (6.07)	2.05 (8.23)	1.10 (5.42)	13.00 (21.13)	16.67 (24.10)	31.33 (34.04)	20.33 (26.42)
T_7	0.05 (1.28)	1.05 (5.88)	1.95 (8.03)	1.02 (5.06)	16.00 (23.58)	20.83 (27.16)	32.67 (34.86)	23.17 (28.53)
T_8	0.12 (1.95)	1.22 (6.33)	2.07 (8.27)	1.14 (5.52)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)	0.00 (0.91)
Mean	0.04 (1.22)*	1.02 (5.77)	1.57 (7.29)	0.87 (4.76)	3.63 (6.27)	4.69 (7.09)	8.00 (9.30)	5.44 (7.55)
	T	P	T x P		T	P	T x P	
SEd	0.021	0.013	0.036		0.047	0.029	0.082	
CD (0.05)	0.041	0.025	0.071		0.094	0.058	0.163	

(*Values in parenthesis are arcsine transformed)

due to good aeration leading to reduced humidity and temperature inside the structure when compared to outside environment. Similar views were expressed by Shanthi and Balakrishnan (1989) and Waskar *et al*. (2004).

In the present study, bulbs stored in low cost bottom ventilated structure showed lowest rooting. Caused by reduced humidity inside the storage structure as higher levels of humidity enhanced root initiation (Jones and Mann, 1963).

Biochemical changes

The highest ascorbic acid (10.24 mg 100g^{-1}), pyruvic acid (2.53µmol g^{-1}) and sulphur content (0.704 per cent) was recorded in T_5 (Spreading of bulbs in ventilated storage). The maximum ascorbic acid (9.71mg 100 g^{-1}) and pyruvic acid (2.47 µmol g^{-1}) content was recorded in P_1 (30 days after storage). and reduced later while sulphur content increased

Table 4. Effect of packing and storage methods on pyruvic acid content (µmol g^{-1}) and sulphur content (%) in onion

Treatment	Pyruvic acid content (µmol g^{-1})				Sulphur content (%)			
	P_1	P_2	P_3	Mean	P_1	P_2	P_3	Mean
T_1	2.48	2.44	2.35	2.42	0.622	0.692	0.745	0.686
T_2	2.50	2.46	2.37	2.44	0.630	0.695	0.755	0.693
T_3	2.59	2.50	2.40	2.50	0.635	0.698	0.765	0.699
T_4	2.44	2.40	2.34	2.39	0.617	0.685	0.740	0.681
T_5	2.60	2.54	2.44	2.53	0.643	0.700	0.768	0.704
T_6	2.39	2.36	2.28	2.34	0.596	0.673	0.688	0.652
T_7	2.40	2.39	2.30	2.36	0.603	0.675	0.693	0.657
T_8	2.35	2.34	2.25	2.31	0.610	0.680	0.713	0.668
Mean	2.47	2.43	2.34	2.41	0.620	0.687	0.733	0.680
	T	P	T x P		T	P	T x P	
SEd	0.004	0.002	0.006		0.005	0.000	0.001	
CD (0.05)	0.007	0.004	0.012		0.001	0.001	0.002	

and highest value (0.733 per cent) was recorded in P_3 (90 days after storage).

Interaction between treatments and period of storage showed that the maximum ascorbic acid (10.06 mg 100 g^{-1}), pyruvic acid (2.60 µmol g^{-1}) and sulphur content (0.768 per cent) was observed in T_5P_1 (Spreading of bulbs in ventilated storage + 30 days after storage) (Table 4 & 5).

Table 5. Effect of packing and storage methods on ascorbic acid (mg 100 g^{-1}) content in onion

Treatment	Ascorbic acid content (mg 100 g^{-1})			
	P_1	P_2	P_3	Mean
T_1	9.75	9.67	9.48	9.63
T_2	9.96	9.83	9.75	9.85
T_3	10.12	9.95	9.82	9.96
T_4	9.68	9.50	9.07	9.42
T_5	10.60	10.12	9.99	10.24
T_6	9.17	9.08	8.93	9.06
T_7	9.47	9.25	9.00	9.24
T_8	8.90	8.68	8.47	8.68
Mean	9.71	9.51	9.31	9.51
	T	P	T x P	
SEd	0.051	0.031	0.087	
CD (0.05)	0.100	0.061	0.174	

In the present study, the quality parameters of all bulbs improved gradually in all the treatments during storage. It might be due to gradual decrease in moisture content of the bulbs during storage and consequent increase in concentration of nutrients present in the tissue. The respiratory rate would be low due to loss of moisture causing increased total sugars as ..... of Misra and Pande (1979).

In the present investigation, the ascorbic acid and pyruvic acid content of the bulbs, decreased gradually with increase in storage period. This may be due to oxidation of L-ascorbic acid into dehydroascorbic acid by enzyme ascorbinase (Joshi and Roy, 1985). The pyruvic acid content also decreased as the storage period increased which was supported by Shock *et al*. (2004). The sulphur content of the bulbs gradually increased in all the treatments as the storage period advanced.

Conclusion

Bulbs with 2cm neck length spread in low cost bottom ventilated storage structure increased the shelf life of *aggregatum* onion cv. CO On 5 up to six months with sustained quality parameters.

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