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Performance analysis of PUSA concentric onion storage structure

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Abstract

Onions are an important vegetable world-wide, ranking second among all vegetables in economic importance having estimated value of \$6 billion dollars annually. Along with significant nutritional value and medicinal properties to the human diet. Onion besides being a highly remunerative crop, not completely stored by farmers because of its perishability, therefore to address the issue Pusa concentric onion storage structure were introduced and tested for its efficiency through On Farm Trial conducted during 2023-2025, in Basen and Kurmikhera village of Chaubeypur and Shivrajpur block of district Kanpur Nagar and Majhiyar and Gahlaun village of The technology has proven highly efficient as weight loss under PUSA concentric structure was 9.00 per cent with comparison to farmers practice of spreading on floor was recorded more than sixteen percent. Average rotting occurred in 11.20 percent onion kept in structure while it was 23 percent in farmers practice. As far as acceptability is concerned 45.83 per cent farmers opines it was good whereas, 78.33 percent farmers were in view that Quality of produce kept in structure was good in comparison with farmers practice.

Keywords: Onion, storage, shelf life, quality, durability, technology, vegetables

Introduction

Despite the country's ability to generate excess food, a significant portion of its population, around one-third, experiences severe poverty (Jatav and Mubeena, 2023)^[2] and thus facing food unavailability. The main responsible factor for food unavailability is the post-harvest losses in fruits and vegetables, which is due to low capacity of food processing, (approximately 2 per cent of fruits and vegetables) (Ministry of Food Processing & Industries, 2022) lack of storage infrastructure facilities (Kumar *et al.*, 2023)^[4], Among the vegetables; tomato, onion, and potato are the top three commodities included in consumption basket consumed by Indian households (Kishore *et al.*, 2022)^[3]. The main problem with vegetable like onion is that on production increases, their prices collapse because lack of enough modern storage capacity in the country (Majunder & Cherala, 2021)^[9]. Onions (*Allium cepa* L. *cepa*) are a major source of flavoring in fresh and cooked food, and are the second most important horticultural crop after tomatoes. Onion is rich in sulfur-containing polyphenol compounds, fructo polysaccharides, and many other health promoting compounds responsible for the strong astringency flavor. Onion is also a vital source of minerals and micronutrients such as calcium and potassium as well as non-essential heavy metal such as selenium, depending on the area of cultivation. In addition to the array of nutrients compositions, onion is well endowed with some important bioactive functional constituents conferring its anti-oxidative, antiplatelet,

antithrombic, antiasthmatic and antibiotic capacities. Flavonoids, specifically quercetin represents the most prevalent phytochemical in onion with its attendant health promoting effects. They are used, produced and traded worldwide. Bulb onions vary in flavor from very mild to extremely pungent when uncooked (Crowtherd *et al.*, 2005) tasted^[1]. While onions contribute significant nutritional value to the human diet and have medicinal properties. Area under onion crop is increasing day by day in district Kanpur. But farmers usually sells all the produce except leaving some portion for household use because of its perishability and unavailability of storage facility, they cannot wait for getting good price, therefore to address the issue of unavailability of storage facility, Pusa concentric onion storage structure were introduced and tested for its efficiency at farmer's field in Kanpur Nagar and Kanpur Dehat as well.

Methodology

As a part of mandatory activity of KVK On-farm trial was done to access the location specific technologies for various farming systems. An On-farm trial of KVK aims to test a new technology/variety or an idea in farmer's field, under farmer's conditions and management, by using farmer's own practice as control. The main advantage for on-farm trials is that it makes it possible to test over a large number of sites, thus it can more easily move research from description to prediction. Knowing what we want to say when the work has been completed should be a critical precondition for undertaking

on-farm, applied research. Based on the background information that the farmers do not adopt about 70% of the available technologies and hence it becomes necessary to take up farmer participatory testing of research findings in their own farms. Apart from convincing them it is also given an opportunity to refine or modify the recommendations to suite the requirements of the farmers in a given farming situation. Participatory Rural Appraisal (PRA) was conducted to identify the problems faced by the farmers and based on the priority of the problems OFT was implemented. Economically viable, operationally feasible technologies matching with farmers needs are identified to solve the problem faced by them.

Present Study is also result of one of On Farm Trial conducted in Basen and Kurmikhara village of Chaubeypur and Shivrajpur Village of district Kanpur Nagar and Majhiyar and gahalaun Village of Block Maitha of District, Kanpur Dehat of Krishi Vigyan Kendra, Kanpur Dehat. All the villages were selected purposively as all are known for their maximum onion area. 10-10 small farmers producing onion were selected and Pusa Concentric Storage structure (with some moderations) of 4.5 quintal capacity were provided to each selected farmers. Structure was provided in the year 2019 in Kanpur Nagar and 2020 in kanpur Dehat, and Data were taken in three consecutive years i.e. during 2019, 2020 and 2021 in kanpur nagar and 2020, 2021 and 2022 in Kanpur Dehat. Onion Storage structure were fabricated by local

artisan on order basis so cost of structure gone quite high as up to 1200 per structure.

Results and Discussion

Table 1: Size of the structure

S.No.	Items	Specification
1.	No. of Tier	5
2.	Length of each tier	2.00 ft
3.	Breadth of each tier	2.5 ft
4.	Height of each tier	2.5 ft
5.	Size of Complete structure (ft)	2.5 X2.5X11.5
6.	Cost	800
7.	Total capacity	4.5 quintal
8.	Capacity of one tier	90 Kg.

As per the Table 1 size and shape of the structure, was compact long and having 5 tiers of 2 feet height and 2.5 feet breadth each and 4 pegs of 1.5 feet height. It was an elongated open cabinet type structure, with 11.5 feet height and approximate 3.5 feet wide. Capacity of each tier is 90 Kg. Storage capacity of complete structure is 4.5 quintal. Manufacturing cost have been bit high due to small no. of storage structure were prepared by local artisan by watching photo, since it has not been seen live, it was difficult to prepare.

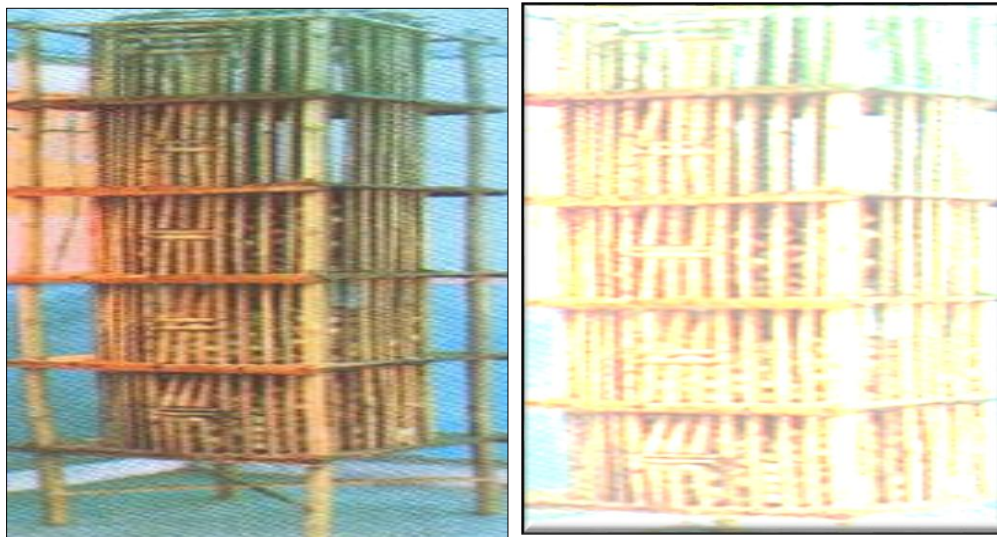


Table 2: Results of the technology with comparison to farmers practice in Kanpur Nagar

S.No.	Parameters	Pusa Concentric Storage Structure				Farmers practice Spreading on ground under bed			
		2023	2024	2025	Avarage	2023	2024	2025s	Avarage
1	Physiological weight loss during storage (%)	9.00	10.6	10.2	9.93	16.5	17.2	17.9	17.2
2	Rotting (%)	8.20	7.3	8.0	7.83	18.0	19.8	18.9	18.9
3	Change in bulb size (m.m.)	2.1	1.8	2.0	1.97	4.5	4.7	4.4	4.53
4	Physical appearance/ Dryness in skin	Slight dryness in upper layer	Colour Slightly changed to brownish	Colour changed to brownish and 1 st layer semi dried	Colour of skin changed but not dried	Colour of Skin of 1 st layer changed brownish	Completely brown	Completely dried with yellowish brow colour	Colour changed and dried completely. Skin started dropping

It is very clear from table 2 that technology given very good results with compare to farmers practice, physiological weight loss was more than 70.00 percent in farmers practice. As far as rotting is concerned 7.83 percent bulb gotten rot inside the structure while it was more than double in case of farmers practice. Only about 2.00 mm size of bulb was changed inside the structure whereas, it was 4.53mm in farmers practice.

Maximum weight loss occurred in 2020 in case of structure

while it was maximum in 2021 in case of farmers practice. Rotting was maximum in 2020 in case of farmers practice but it was maximum in case of 2019 because of handling of technology. Since it was quite new in that particular year. Some handling issues has been observed. Change in size of bulb was also recorded highest in 2019. Overall performance of the structure was found far more better than farmer practice.



Performance of farmers practice



Performance of technology

Table 3: Results of the technology with comparison to farmers practice in Kanpur Dehat

S.No.	Parameters	Pusa Concentric Storage Structure				Farmers practice Spreading on ground under bed			
		2023	2024	2025	Average	2023	2024	2025	Average
1	Physiological weight loss during storage (%)	10.4	11.3	10.9	10.87	17.5	18.2	18.1	17.93
2	Rotting (%)	7.67	8.45	8.30	8.14	18.9	19.10	19.7	19.23
3	Change in bulb size (m.m.)	2.1	2.5	2.4	2.33	4.3	5.2	5.0	4.83
4	Physical appearance/ Dryness in skin	Slight dryness in upper layer	Colour Slightly changed to brownish	Colour changed to brownish and 1 st layer semi dried	Colour of skin in turning somewhat yellowish brown	Colour of Skin of 1 st layer changed brownish	Completely brown	Completely dried with yellowish brown colour	Upper layer dried completely and started dropping up to some extent

Table 3 envisages physiological weight loss was as high as 17.93 percent in with compared to 10.83 in technology while rotting was found less than half in technology. As far as size of bulb is concerned it was 2.33 mm shrank inside the structure while 4.83 mm shrinkage was recorded in farmers practice. In three months inside the structure colour of was

turning to brown and dried up to some extent but in farmers practice the upper layer started dropping.

High weight loss was observed in 2021 and 2022 because temperature was recorded highest in these years. Same has also been observed in all the parameters considered under study.



Performance of PUSA concentric storage structure



Results Farmers practice of storing onion

Table: 3 Month wise average performance of technology in Kanpur Nagar in 2023-2025

Parameters	Technology				Farmers Practice			
	May	June	July	Average	May	June	July	Average
Physiological weight loss during storage (%)	1.4	2.6	3.1	2.37	2.4	3.7	4.2	3.43
Rotting (%)	1.3	1.7	3.2	2.07	4.5	4.9	6.3	5.23
Change in bulb size (mm)	0.2	0.1	1.5	0.81	5	3	4	4.3
Physical appearance/ Dryness in skin	1 st layer semi dried, Wrinkly	1 st layer semi dried, Wrinkly	Wrinkling started 2 nd layer	colour of Skin of 1 st layer started changing to brownish	1 st layer dried, Wrinkly	2 nd layer semi dried, Wrinkly	2 nd layer completely dried	colour of Skin of 1 st layer changed brownish and started dropping

Data depicted in table 4 describes last year month wise performance of structure I.e. almost forty five percent less physiological weight loss was recorded inside the structure while more than 1.5 times more rotting was observed in case of farmers practice. Size of bulb was quite reduced in farmers

practice while in structure less than 1.00 mm size of bulb was reduced. Colour of skin was turning yellowish brown in but in case of farmers practice skin started drooping after turning dry and brown in colour.

**Farmers practice****Onion kept in storage Structure****Table: 4** Month wise average performance of technology in Kanpur Dehat in 2023-2025

Parameters	Technology				Farmers Practice			
	May	June	July	Average	May	June	July	Average
Physiological weight loss during storage (%)	1.1	1.9	2.3	1.11	2.2	2.8	3.9	2.97
Rotting (%)	1.3	1.9	2.9	2.03	3.9	5.5	6.7	5.37
Change in bulb size (mm)	0.25	0.2	2.1	0.85	3.2	2.5	2.6	2.77
Physical appearance/ Dryness in skin	1 st layer semi dried, Wrinkly	1 st layer semi dried, Wrinkled	Wrinkling started in 2 nd layer	colour of Skin of 1 st layer started changing to yellowish brown	1 st layer dried, Wrinkly	2 nd layer semi dried, Wrinkly and brownish	2 nd layer completely dried and yellowish	colour of Skin of 1 st layer changed brownish and started dropping

As per data displayed in table 5 maximum change in weight was observed in both the case because of rise of temperature. Rotting was also highest in July due to rains and humidity but in farmers practice it was 6.7 on the other hand it was as less as 2.9 in case of technology. Change in size of bulb was

recorded highest in the month of July in case of structure but in farmer's practice it was found highest in the month of May. Physical appearance was changed somewhat in technology but it was changed completely in farmers practice.



Onion stored in storage structure in July



Onion stored in farmers practice in July

Table 6: Attitude of farmers' towards technology N= 48

S. No.	Items	Good	Fair	poor
1	Quality of produce kept in structure	78.33	21.67	00
2	Design of the structure	26.50	18.50	55.00
3	Price	12.00	32.00	56.00
4	Feasibility	45.83	20.83	33.33
5	Durability	37.50	18.75	43.75
6	Availability (Construction)	10.41	12.50	77.1
7	Size	16.67	14.58	68.75

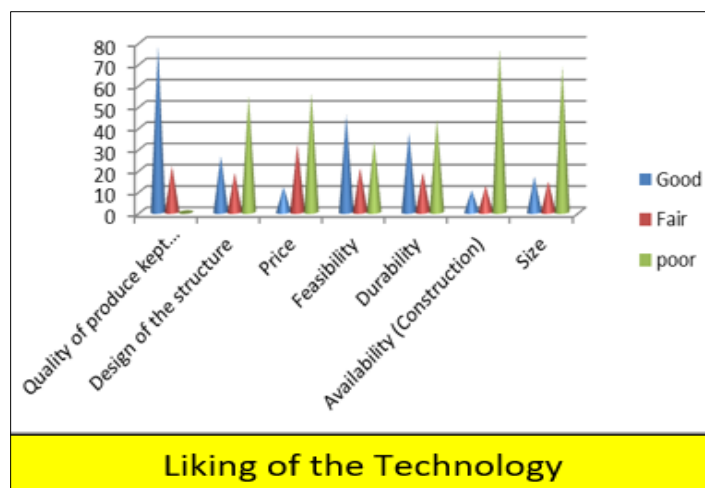
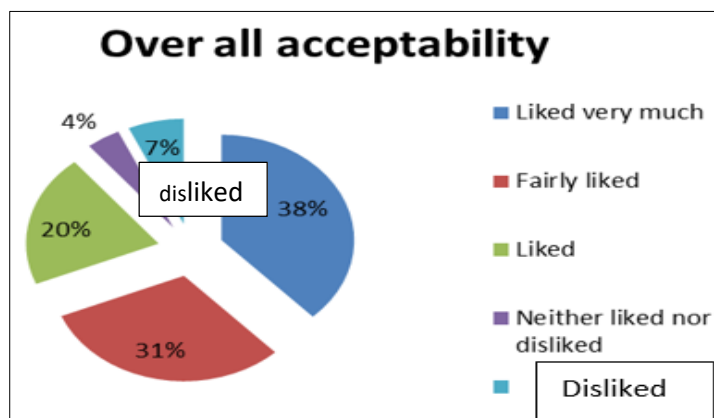
**Fig 1:** Attitude of farmers towards technology**Fig 2:** Overall acceptability of technology

Table 6 and fig 1 describing the attitude of farmers towards technology clearly depicts that 78.33 percent farmers liked

the quality of produce kept in structure while 56.00 percent did not like the price. About forty four percent farmers not

liked the durability as after 3 years it started breaking perhaps because of its elongated shape. As far as overall acceptability is concerned it is given in fig-2 38.00 percent liked it very much but in contrast 7.00 percent disliked the technology because of its costly fabrication and elongated shape which exceeds labour of putting the produce so high.

Conclusion

Onion crop being harvested during the *rabi* accounts for 60% of production, hits the markets from March to June. The same crop continues to meet the consumer demand till October-November every year before the *kharif* crop is harvested and brought to the market. Therefore, it becomes pivotal to successfully store *rabi* onion so as to maintain its supply in the markets. The Onion is a semi-perishable crop and 30-40% of the crop gets lost during the storage. Pusa concentric storage structure is good option for small farmers as physiological weight loss during storage is almost half as compared to farmers practice while was more than double in case of farmers practice. Only about 2.00 mm size of bulb was changed inside the structure. In case of Physical appearance Colour of skin was pale brown in case of Pusa concentric storage structure but in farmers' method it was completely dried and dropped. In fact results of the technology were good. But design of the technology was not appropriate and since it's made up of bamboo and quite elongated in shape, it was not found durable too. As far as availability is concern it's not available anywhere but can very easily be constructed by local artisan. Over all response of farmers was positive towards technology but needs some moderation. As per farmers response this can be a good options for small sellers. It is recommended to train local artisans and some moderation of design should be done to popularize the technology.

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