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An innovative onion storage structure

India is the second largest producer of onion contributing about 20% of the world production. Onion is cultivated both during monsoon and post-monsoon seasons. The latter is preferred by the farmers for its superior quality, larger and uniform bulb size, and better storability. However, incidence of unseasonal rainfall, unstable market prices, lack of adequate storage facility leads to distressed sales and spoilage of onions. This necessitates the development of low-cost durable storage structures at a farmers' field. Therefore, a single span hut shape structure (60' L × 5' B × 7' H) with east-west orientation has been developed using MS pipes, metal wire mesh, tarpaulin/shade net etc. Such innovative on-farm, affordable, and sturdy storage structures are ideal for storing about 30 tonnes of onions for six months during the summer when the market is always glutted. This structure also helps in maintaining a better micro-climate for enhancing shelf-life and minimizing storage losses. Onion stock stored in such structure shall help to get assured price to farmers and maintain market stability during the lean period of August to November of the year.

ONION is one of the most important commercial vegetable crops grown in India. It is grown in western, northern as well as in southern India. Maharashtra, Gujarat, Uttar Pradesh, Odisha, Karnataka, Tamil Nadu, Madhya Pradesh, Andhra Pradesh and Bihar are major onion-growing states in India. However, in Maharashtra, onion is being cultivated during all the seasons starting from *kharif*, late *kharif* and *rabi*. However, the crop transplanted in *rabi* season is ready for harvesting during the summer season and has better storage life in comparison to the onion crop grown in other seasons.

Onion production and export statistics

In Maharashtra, farmers from the major onion growing belts like Nashik, Pune and Ahmednagar cultivate onion crops in all three seasons and other onion growing districts are Dhule, Jalgaon, Satara and Solapur. In India, onion is grown in 12.20 lakh hectares with 228.19 lakh MT of production during 2018-19 (NHB, 2018-19). In 2016, total onion production was 209.31 lakh MT of which 65.29 lakh MT (nearly 31.19%) was recorded in Maharashtra. During 2017-18, onion export from Maharashtra was 10.54 lakh MT with a share of 66.37% of total export.

Onion marketing and storage scenario in summer season

The onion cultivation in some regions of Maharashtra during the *rabi* season is majorly based on the production and market trends during the preceding years and the availability of resources. The *rabi* season onion crop is becoming ready for harvest during the summer season. However, bumper production during summer months creates a glut in the market. In the same period, the prevailing market prices are very low and some of the farmers sell their produce in distress due to a lack of their own storage structure. Since onion is a bulk commodity, storing onion in large quantities is a challenging issue. The quality and safety of onions depend on proper pre- and post-harvest handling and storage conditions. The proper field and shade curing is the most important post-harvest operation for the storage of onions (Fig. 1). Other factors like choice of varieties and agronomic practices also have a major role in onion bulb quality and storage life. However, due to the unavailability of a proper storage facility at the farm, the onion produce in the summer season is sold in the market. Further, it is procured by

Fig. 1. Shade curing of onions before storage

large onion traders in which some of the quantity is stored based on the various quality parameters, and the ability of onion bulbs to retain scales and remaining produce is traded through the marketing chain. If the market price is below average during the harvesting season, then farmers prefer to store their produce but there is always a shortage or unavailability of storage structures. Traditionally onion storage was done in wooden and bamboo and made storage structures with a tin sheet covering near the farmers' fields in the villages. However, due to the unavailability of raw material and high yearly maintenance of traditional wooden structures which are also prone to termites attack, these types of structures are rarely seen in the villages. However, in this situation portable/knock-down, low-cost, durable onion storage structures can be erected.

On-farm, low-cost, durable onion storage structure

Design specifications: The design of the structure is the most important aspect for minimizing the storage losses in the onion and specifications are given in Table 1. The ideal orientation of the structure is the East-West direction because the pre-monsoon winds blow from the south-western direction where the cool air will easily pass through the buffer space of the arch and metal wire mesh from the side of the structure. The structure should be erected at an elevated level near the roadside for loading produce during the rainy season. Further monsoon rains from the southwest direction will have less impact on wetting the side wall of the structure, where onions will remain dry during the rainy season. This structure maintains cool, dry and well-ventilated conditions for proper storage.

Table 1. Design specification for single span onion storage structure

Parameter	Specifications
Type of structure	Single span hut shape
Structure orientation	East-West
Length	60 feet
Width	5 feet
Side height	6 feet
Ridge / center height	7 feet
Floor height from ground level	2 feet

Erection and storage process: The material required for the structures can be easily sourced from the local market and details are given in Table 2. Once the material is ready, the erection of the structure can be done in five hours. The structure consists of 12-unit frames spaced at 5 feet distance from the unit to a unit which are fastened with nuts and bolts. Further, these individual units are inter-connect with the bottom, middle and upper supporting MS pipe through the length of the structure (Fig. 2).

Table 2. Material required for erection of low-cost onion storage structure

Material	Specifications
Square MS pipes	1.5 × 1.5 inch with 2.5 mm thickness = 300 kg 1.0 × 1.0 inch with 2.5 mm thickness = 70 kg
Metal wire mesh	5 feet width (1.5 inch)
Shade net	120 feet length × 8 feet width with 70% shade factor
Tarpaulin sheet	60 feet (400 micron)
Other fixing materials	Nut-bolts, GI wire, nylon rope

Fig. 2. Inter-connected of structure using MS pipes

Once the frame of the structure is erected, then a metal wire mesh is placed from the inner side of the structure and tied at the top, middle, and bottom with binding wire. Later nylon rope is intertwined in a zig-zag manner for additional support to avoid stretching or widening of the structure once the onions are stored. The structure is covered with the hut shape arches, then GI wire is placed over the roof to support the cladded shade net and tarpaulin (Fig. 3a and 3b).

Fig. 3a. Placing of arches on the structure

Fig. 3b. Structure is covered with shade net

Micro-climate and storage capacity: The microclimate inside the structures remains most congenial for better storage life of the onion. Since the metal wire mesh is used as a side supporting material, it will help in proper ventilation. Further, the shade net is covered over the structure during the summer months until the first monsoon rains. In contrast, traditional structures are covered with tin sheets which inherently builds up the temperature inside the structure, whereas in this type of structure, the shade net blocks the intense solar radiations to avoid temperature build-up inside the structure. Since shade net is a porous material, it will help to exchange inside warm air with the open air. The storage capacity of this structure is up to 300 quintals.

Cost of the structure and storage losses: The structure is made of square MS pipes and other accessories are of very low cost. The total unit cost of the structure is approximately ₹ 50,000/-. However, it may vary based on the changes in the market price of the material required. Therefore, based on the storage structure and erection cost, the quantity of onion stored will cost nearly ₹. 167 per quintal of onions. On the contrary, the charges for a rented onion storage structure are ₹. 140/ quintal in the Nashik district of Maharashtra. The storage losses in this type of on-farm onion storage structure are very low around 8-10% due to proper ventilation. However, it may vary based on the rainfall and humidity of the local conditions. The complete erection and storage procession is given in Fig. 4.

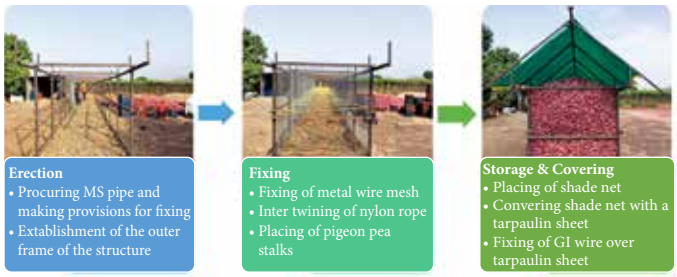

Fig. 4. Complete erection and storage process

Advantage of the structure

- Easy to install with any PCC material
- Low cost, durable and portable/knock-down structure
- Maintain better micro-climate for better storage life
- Very low storage cost per quintal of onion
- Minimum storage losses
- Alternative use during the rest of period

Hence, such innovative on-farm, low-cost, durable onion storage structures are highly suitable for onion storage during the summer season when there is always a glut in the market. In other cases, lack of such storage facilities, on-farm at the production level leads to distress sell of the produce. Therefore, this type of onion storage structure can be easily erected within a short period of time where a large volume of onions can be stored at the producer's level. In this way, large onion stock can be stored in farmers' fields, which can also help in maintaining market price stability during the lean period. This stored onion produce will get an assured remunerative price during the lean period (August to November months) when market rates usually remain high. Additionally, the design and cladding material used for the structure help to maintain a better micro-climate for storage where storage losses are minimal.

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Tractor-operated raised-bed former-cum-planter for multiplier onions

A tractor-operated raised-bed former-cum- onion bulb planter has been developed for planting multiplier onions. The drive to the metering unit is derived from the ground wheel. A shoe-type furrow opener is fitted to the planting frame in front of onion bulb delivery tube. A funnel-shaped box was also fitted at the bottom of the seed delivery tube to prevent spillage of the onion bulb outside the furrow. This ensures an uninterrupted free-fall of the onion bulb from metering disc to furrow. The furrow opener assembly was mounted independent to the planter unit hence it can be positioned as required to ensure proper row spacing. The effective field capacity of the machine was 0.3 ha/h with field efficiency of 75%.

Source: ICAR Annual Report 2022-23