Comparative Trial Report on Onion Storage System(1MT) at Vigyan Ashram

Project Name: Regulation and Storage Optimisation for Preventing Onion Sprouting and Decay.

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Duration:10/4/2026 to 18/5/2026

Vigyan Ashram

Design Innovation Center

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Natural Ventilation vs Forced Ventilation

1. Introduction- A one-month storage trial was conducted to compare the performance of two onion storage systems:

1. Natural Ventilation(NV) Storage
2. Forced Ventilation(FV) Storage

The objective of this trial was to evaluate weight loss, rotting, flake formation, and the quantity of usable onions after storage. Each storage unit was loaded with 1000 kg of onions under similar environmental conditions at Vigyan Ashram, Pabal. One unit has natural air ventilation; the other has a blower for forced-air ventilation.

2. Airflow Conditions - For efficient removal of heat in onions, we selected a specific time throughout the day. Every hour, 5 min ON from 7 am to 10 am, and 3 pm to 10 pm. Every one and a half hours from 11 am to 2 pm and 11 pm to 5 am.

Specification of Hicool Blower - Model CFB2E-150S

Model	Size (mm)	Phase	Voltage (VAC)	Frequency (Hz)	Current (A)	Power (W)	Speed (RPM)	Airflow (m^3/hr)	Noise (dBA)	Capacitor (µF/450V)	Weight (Kg)
CFB2E-150S	Φ150×65	Single	230	50	1.0	220	2300	475 CMH (280 CFM)	60	4.0	3.8



Image 1. Natural Ventilated and Forced Ventilated onion storage unit

3. Observations and Data

Overall Storage Performance

Sr. No	Parameter	Natural Ventilation	Forced Ventilation
1	Initial Weight (kg)	1000	1000

Sr. No	Parameter	Natural Ventilation	Forced Ventilation
2	Total Weight Loss	67.52 kg (7%)	90.38 kg (9%)
3	Usable Onions	911 kg	895 kg
4	Rotten Onions	14.36 kg (1.4%)	10 kg (1%)
5	Flakes	6.76 kg (0.6%)	5 kg (0.5%)

Layer-wise Rotting Distribution

Layer	Natural Ventilation	Forced Ventilation	% Difference in NV and FV
Top Layer	1.6 kg	1.5 kg	6%
Middle Layer	4.2 kg	6 kg	-43%
Bottom Layer	8.56 kg	2.5 kg	70%
Total Rotten	**14 kg**	**10 kg**	**28%**

4. Analysis

Weight Loss- The forced ventilation system showed a higher overall weight loss of 9% compared to 7% in the natural ventilation system. This may be due to increased airflow, which causes greater moisture removal from the onions.

Usable Onion Recovery: Natural ventilation has slightly more usable onions (911 kg) compared to forced ventilation (895 kg). Although forced ventilation reduced rotting, the increased moisture loss contributed to a lower final usable weight.

Rotting Performance- Forced ventilation performed better in reducing total rotting:

- Natural ventilation: 14.36 kg of rotten onions
- Forced ventilation: 10 kg of rotten onions

This indicates that airflow helped reduce moisture accumulation and microbial activity inside the storage structure.

Layer-wise Rotting Pattern- A significant observation was found in the bottom layer:

- Natural ventilation had maximum rotting at the bottom layer (8.56 kg).
- Forced ventilation reduced bottom-layer rotting to only 2.5 kg.

This suggests that forced airflow improved air circulation near the lower section of the storage, where moisture accumulation is generally higher.

However, the forced ventilation system showed slightly higher rotting in the middle layer (6 kg), indicating uneven airflow distribution inside the structure.

Flake Formation- Forced ventilation also reduced flake formation slightly:

- Natural ventilation: 0.6%
- Forced ventilation: 0.5%

This indicates better preservation quality under controlled airflow conditions.

4. Conclusion

The one-month trial demonstrated that forced ventilation improved storage quality by reducing rotting and flake formation, especially in the bottom layer of the storage structure. However, the system also caused higher overall weight loss due to increased moisture removal.

Natural ventilation showed lower weight loss and slightly higher usable onion weight, but experienced higher rotting, particularly at the bottom layer.

Overall:

1. Forced ventilation is more effective for reducing spoilage.
2. Natural ventilation is better for minimizing moisture loss.
3. Further optimization of airflow distribution in the forced-ventilation system may help reduce middle-layer rotting and improve overall storage efficiency.
4. From the comparison, we have decided to block upper-level holes as they are not adding any changes in both systems - natural and forced ventilation.