Received: 15 May 2019 | Revised: 6 August 2019 | Accepted: 17 September 2019

DOI: 10.1111/jfpe.13280

ORIGINAL ARTICLE

Journal of Food Process Engineering WILEY

Nonlinear and multiple linear regression analysis of airflow resistance in multiplier onion

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Funding information
AICRP on Post Harvest Engineering and Technology - ICAR; Jawaharlal Nehru Memorial Fund (JNMF); Jawaharlal Nehru Memorial Fund

Abstract

The estimation of horizontal and vertical airflow resistance is essential for fabricating storage cum curing structure for multiplier onion. The horizontal and vertical airflow resistance of multiplier onion (var. CO-4) was investigated at three different moisture levels of 80.8, 84.2, and 88.8% w.b., and the airflow rates varied from 1 to 1.7 $m^3\ s^{-1}\ m^{-2}$. The horizontal airflow resistance was studied at three different depths of fill of 10, 20, and 30 cm. The resistance of multiplier onion to airflow increased significantly with increasing depth of fill, moisture content, and airflow rate. Models, namely Shedd's, Hukill and Ives equation, were investigated to explore the horizontal airflow resistance of onion. Shedd's equation was found to be the most suitable model with a high coefficient of determination and low RMSE value. The vertical airflow resistance was studied at a depth of fill of 5–15 cm and spacing between racks of 20–40 cm. The airflow resistance may be best expressed by the linear model with the highest adjusted R^2 of .842 and a predicted R^2 of .8053. The optimum curing conditions were obtained at an airflow rate of 1.15 $m^3\ s^{-1}\ m^{-2}$, 14.5 cm depth of fill, and 35 cm spacing between racks.

Practical applications: Multiplier onion being an important spice crop in southern parts of India, the effective storage of the same becomes very essential. Under monsoon conditions, farmers face heavy postharvest losses of rotting and sprouting caused due to improper aeration within the storage structures. The efficient designing of storage structure requires data on the effect of airflow rate, depth of filling, and spacing between racks. The airflow resistance data are vital for optimizing the dimensions of the storage structure. The effect of these parameters and their interactions has been analyzed for the first time using nonlinear and multiple linear regression analysis. The optimized design dimensions could be utilized by farmers for constructing an optimal storage structure for multiplier onion with minimal storage losses even under monsoon conditions.

1 | INTRODUCTION

Allium cepa var. L. *aggregatum* also known as multiplier onion is cultivated in the southern states of India namely, Tamil Nadu, Andhra Pradesh, and Karnataka. Curing is a process of drying the onions to remove the excess moisture from the neck, root, and one or two outer most layers of freshly harvested onion. The high moisture content of the onion (80–89% w.b.) makes the onion unfit for long-term storage. Proper curing and storage are the most important unit operations to produce good quality onion without mold growth and sprouting to increase the marketability and profit to the producers.

