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USDA Pecan Postharvest - Industry 4.0

A. Heydarzade¹, J.Rao¹

¹ Department, Institution, and location (College of Engineering, University of Georgia, Athens, GA, USA).

*Corresponding author: Ayoub.Heydarzade@uga.edu

Abstract

Pecans, annually producing 300 million pounds across 15 states, hold a significant position in the U.S. agricultural sector. However, pecan post-harvesting operations have historically been slow to adopt new technologies for enhanced efficiency and productivity.

This study aims to transform the pecan production landscape by incorporating Industry 4.0 technologies such as IoT, cloud technology, sensors, machine learning, data analytics, and real-time monitoring. These advanced technologies can substantially improve efficiency and product quality, leading to a more sustainable and profitable pecan industry.

The research thoroughly examines the pecan production line, comprising moisturizing, cracking, and shelling, focusing on identifying input and output variables and parameters for each process. Industry 4.0 technologies, including sensors, IoT, and cloud-based systems, are employed to measure and collect data during the experimental process, paving the way for optimization opportunities and a comprehensive understanding of the production processes. Statistical learning and machine learning techniques are utilized to analyze relationships and correlations between these parameters and their impact on process efficiency and half yield output.

Upon determining optimal parameter levels, advanced control systems are implemented for precise monitoring and control of the entire production line. This approach enhances half yield output while reducing end product variability. Real-time monitoring and feedback loops enable



continuous improvement and adaptation to changing conditions, ensuring the pecan production process remains agile and responsive.

In conclusion, this study highlights the transformative potential of Industry 4.0 technologies in the pecan production industry, leading to a more efficient, sustainable, and profitable sector while providing significant benefits and paving the way for future innovation and growth.

Keywords: Pecan production, Industry 4.0 technologies, Process optimization, Real-time monitoring