INVESTIGATION OF SEED MONITORING POTENTIAL USING LIGHT DEPENDENT RESISTOR (LDR) FOR CELL TYPE PRECISION SEEDERS

Md Rejaul Karim[1], Kyu-Ho Lee[1,2], Md Nasim Reza[1,2], Md Asrakul Haque[1], Md Razob Ali[1], Tuanpeng Tu[1,2], Dae-Hyun Lee[1,2], Sun-Ok Chung[1,2*]

[1] Department of Agricultural Machinery Engineering, Graduate School, Chungnam National University, Daejeon 34134, Republic of Korea. [2] Department of Smart Agricultural Systems, Graduate School, Chungnam National University, Daejeon 34134, Republic of Korea.

*Corresponding Author: sochung@cnu.ac.kr

ABSTRACT

Precision seeding is an important operation in modern agriculture, ensuring accurate seed placement at defined rates and intervals to optimize crop performance. Despite their critical importance, conventional seed metering devices often require frequent manual calibration, making them labor-intensive, inefficient, and impractical for both smallholder and large-scale farming operations. Existing seed monitoring technologies are often costly and lack real-time adaptability to varying field conditions. This study aimed to evaluate the feasibility of a cost-effective, adaptable, real-time seed monitoring solution using a light-dependent resistor (LDR) sensor integrated with a microcontroller. A laboratory test bench was developed to evaluate the accuracy of radish seed detection in cell-type seed metering devices. The LDR sensor was interfaced directly with the microcontroller via general-purpose input/output (GPIO) pins, and a specialized algorithm was developed to capture real-time changes in sensor states at two-second intervals. Seed drop events were systematically recorded in a CSV file, enabling quantitative analysis to distinguish successful detections from missed events. In experimental trials conducting 186 seconds, 93 seed drops event were recorded. The seed detection algorithm successfully identified 87 seeds and missing 6, resulting in an overall accuracy of 94%. The sensor setup also provided real-time visual feedback of seed drop patterns, demonstrating the effectiveness for seed flow monitoring. The LDR sensor setup performed well under laboratory conditions, but showed limitations, including ambient light interference and lower sensitivity during high-frequency seed drops. Future research will focus on increasing detection frequency, applying advanced adaptive filtering methods, and enhance overall system reliability and robustness under variable field conditions.

Keywords: Smart agriculture, precision seeding, seed monitoring, photoelectric sensing, LDR sensor

INTRODUCTION

Precision seeding is essential for ensuring uniform seed distribution in the field, directly contributing to enhance productivity. Missing or multiple seed drops during seeding cause non-uniformity, which can lead to yield losses. The seed meter directly influences the seed placement performance; however, detecting seed drops and misses remains challenging, particularly in large-scale operation (Xie et al., 2021; Zagainov, et al., 2023; Xu et al., 2023). The study aimed to evaluate the feasibility of a cost-effective, adaptable, real-time seed monitoring solution using a light-dependent resistor (LDR) sensor integrated with a microcontroller.

MATERIALS AND METHODS

A laboratory seed monitoring test bench was prepared, and LDR sensor was directly interfaced to evaluate the accuracy of radish seed detection in cell-type seed metering devices. Over 186 seconds, a total of 93 seed drops were recorded. An algorithm was implemented to monitor real-time changes in the LDR sensor at two-second intervals for detecting seed drops and misses. Mapping of 50 seed placements across two rows, using five complete rotations of the seed meter, was performed.
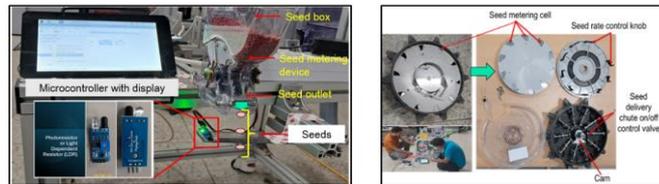

Fig.1 Sensor setup and data collection (left side), cell type seed meters (right side).

RESULTS & DISCUSSION

The developed monitoring system accurately detected 87 seeds and missed 6 seeds, achieving an overall detection accuracy of 94%. Mapping results indicated seed drop accuracies of 92% and 84% in the first and second rows, corresponding to missing rates of 8% and 16%, respectively.
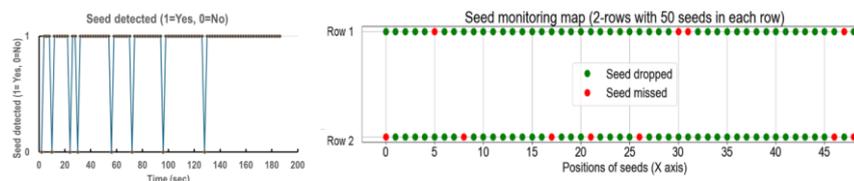

Fig.2 Seed detection performance (left side), seed monitoring map (right side).

CONCLUSIONS

Seed drop patterns are visualized with real-time feedback demonstrating the practical effectiveness in monitoring the seed flow. Limitations such as interference from ambient lighting and reduced sensitivity were identified during high-frequency seed dropping.

ACKNOWLEDGEMENTS

REFERENCES

Xie, C., D. Zhang, L. Yang, T. Cui, X. He, and Z. Du. 2021. Precision seeding parameter monitoring system based on laser sensor and wireless serial port communication. Computers and Electronics in Agriculture 190: 106429.

Zagainov, N., N. Kostyuchenkov, Y. X. Huang, A. Sugirbay, and J. Xian. 2023. Line laser based sensor for real-time seed counting and seed miss detection for precision planter. Optics and Laser Technology 167: 109742.