Evaluation of a Seed-Fertilizer Application System Using a Laser Scanner

P. Weckler[1], N. Wang[1], C. Zhai[2], L. Zhang[3], B. Luo[4], J. Long[1], R. Taylor[1]

[1]Oklahoma State University, [2]NW A&F University, Yangling, Shaanxi, China, [3]South China Agricultural University, Guangzhou, Guangdong, China, [4]National Engineering Research Center for Information Technology in Agriculture, Beijing, China

A paper from the Proceedings of the
13th International Conference on Precision Agriculture
July 31 – August 4, 2016
St. Louis, Missouri, USA

Abstract. The system evaluated is a design that combines planter and sprayer technologies to allow clients to plant crops while simultaneously spraying initial fertilizer on or in close proximity to the seed. The system is an idea Capstan Ag Systems has been pursuing for around 15 years, and has recently been revived in a partnership with Great Plains Manufacturing Company. Great Plains Manufacturing released the final product under the name **Accushot™** at the 2015 Agritechnica Farm Show in Hannover, Germany. When planting, particularly corn in twin or narrow rows, it is difficult to spray initial fertilizer while planting seeds. In the past, this has been done by walking behind the planter and using backpack sprayers to apply the initial fertilizer on quarter sections of the field. Agronomists have found that the survival rates and condition of the plants are significantly better if the initial fertilizer is applied in the furrow with the crop seed. Therefore, it would be beneficial for farmers to have the technology, such as **Accushot™**, which applies the initial fertilizer in the furrow while planting the seed. However, in order for it to be marketable to farmers, the system would need to include a method of verifying the machine's performance.

Keywords. Seed-Fertilizer, Laser scanner, Data fitting, Verification system

Introduction

The system evaluated is a design that combines planter and sprayer technologies to allow clients to plant crops while simultaneously spraying initial fertilizer on or in close proximity to the seed. The system is an idea Capstan Ag Systems has been pursuing for around 15 years, and has recently been revived in a partnership with Great Plains Manufacturing Company. Great Plains Manufacturing released the final product under the name **Accushot™** at the 2015 Agritechnica Farm Show in Hannover, Germany. When planting, particularly corn in twin or narrow rows, it is difficult to spray initial fertilizer while planting seeds. In the past, this has been done by walking behind the planter and using backpack sprayers to apply the initial fertilizer on quarter sections of the field. Agronomists have found that the survival rates and condition of the plants are significantly better if the initial fertilizer is applied in the furrow with the crop seed. Therefore, it would be beneficial for farmers to have the technology, such as **Accushot™**, which applies the initial fertilizer in the furrow while planting the seed. However, in order for it to be marketable to farmers, the system would need to include a method of verifying the machine's performance.

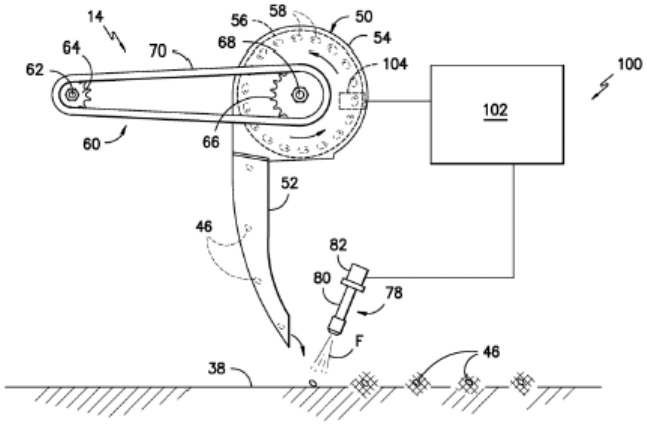

Fig. 1 The seed tube and sprayer layout of seed squirter

So an automatic seed squirter verification system based on a laser scanner was developed to real-time acquire the coordinate information of the corn seed and fertilizer. Using the coordinate information, motion trail of seed and spray could be drawn at different seeding speeds. The system can be used in verification of the seed squirter's performance to improve the utilization ratio of fertilizer.

Materials and Methods

The key component of this verification system was a laser scanner (LMS291, SICK AG, Waldkirch, Germany) which measured distances between the sensor and target objects based on the time-of-flight principle. It was configured to operate in continuous line scan mode with a field of view of 100°and a resolution of 0.25°, the measurement number is 401 data points in every scan period.

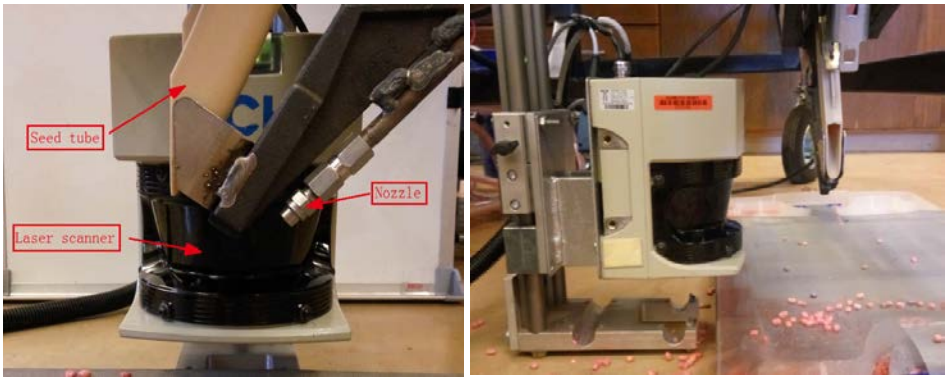

Fig. 2 The laser line scan sensor and the seed squirter

A control program developed in LabVIEW (National Instruments Co., Austin, Texas, USA) was used to establish the communication between a laptop computer and the laser scanner, to receive data packages, to extract distance data and convert them from polar to Cartesian coordinates, and to save the data into a file with MS Excel format.

Results and Discussion

The laser scanner could collect valid data, which proved that the system could meet the detection requirements.

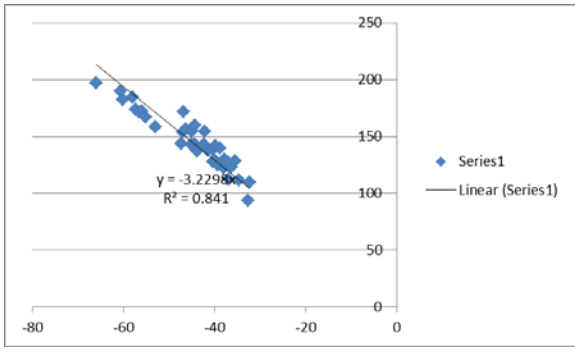

Fig. 3 Fertilizer position data

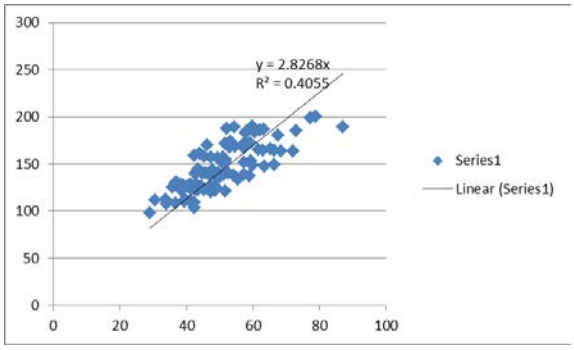

Fig. 4 Corn position data

Conclusion or Summary

(1) An evaluation system for a seed-fertilizer application system was setup using a laser scanner which could acquire the coordinate information of the corn seed and fertilizer in real time.

(2) In the evaluation tests, the distances between dropping lines of corns and fertilizer at two different heights were measured. An equation was obtained which could be used to calculate the distance between corns and fertilizer on the ground.

(3) In the future research the evaluation system and the row unit could be setup together to make it easier and more precise to set their relative positions.