COMPUTERIZED SYSTEM IN COTTON HARVESTER FOR MEASUREMENT OF SEEDCOTTON YIELD

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Abstract

A computerized system for direct measurement of seedcotton yield was installed on a John Deere 299 cotton picker and on an Allis Chalmer 860 broadcast-header stripper. The measuring system has three main components: a) a weighing basket, b) a distance measuring device, and c) a computerized control/data acquisition system. A weighing response test showed an average bias of 4.1%. The average of these four measurements showed a 4.1% bias. Each measurement was obtained as an average of 10 3-sec interval readings (harvester engine running). Typical variability of 10 individual 3-sec interval readings was small (coefficient of variation near 0.1%). This computerized measuring system has been extensively and successfully used from 1995 to 1998 seasons for measuring experimental plot yields in Uvalde.

Introduction

During the summer of 1995, a computerized system was developed for measurement of seedcotton yield using a cotton picker. This system was installed in a refurbished old John Deere 299 cotton picker. The purpose of this development was to create a tool for simplifying the harvest of experimental plots. In 1998, an identical measuring system was incorporated onto an Allis Chalmer 860 broadcast-header stripper.

System Description

The measuring system has three main components: a) a weighing basket, b) a distance measuring device, and c) a computerized control/data acquisition system. These three components are briefly described in the section below.

Weighing Basket

A collection basket was built to fit the inside of the original, factory-made collection basket of the harvester; herein these baskets are called inner and outer basket respectively (Fig. 1). The inner basket is supported by four stainless steel electronic loadcells bolted to reinforced corners of the outer basket's upper frame. These loadcells connected in parallel and controlled by a computer provide a continuous measurement of the weight of harvested seedcotton and its container (the inner basket) to a resolution of 0.15 kg.

Four stabilizers linking the inner basket bottom frame to the outer basket frame provide enhanced stability to the inner basket by preventing lateral movements on the plane of the basket floor and allowing frictionless movements perpendicular to the plane of the basket floor. This structure allows for normal cotton load dumps using the harvester's hydraulic-driven mechanism.

Travel Measuring Device

The distance traveled by the harvester is measured at 0.16 m intervals by means of proximity sensors affixed to the wheel axles. By knowing the starting point of travel, this distance measuring system also provides a crude method of geo referencing.

Computerized Control/data Acquisition System

An on-board computer (21X Micrologger, Campbell Scientific Inc., Logan, Utah) logs the electronic signals produced by the basket loadcells and the wheel proximity sensors. This computer also controls the excitation to loadcells and proximity sensors, as well as, sends "basket full" and "logging" signals to the driver's cabin. The data can be either stored in the datalogger for latter retrieval or transferred immediately to an on-board laptop computer for real-time display of output data.

Weighing Test and Use of System

A weighing response test was conducted by placing a 2-kg mass at each of the four corners of the inner basket. This test showed small differences depending on the placement of the test weight (Fig. 2). The average of these four measurements showed a 4.1% bias. Each measurement was obtained as an average of 10 3-sec interval readings (harvester engine running). Variability of these individual 3-sec readings was small (coefficient of variation near 0.1%).

Plot seedcotton yield is calculated for each of the experimental plots using the difference between weights measured before and after harvesting a plot, the distance traveled along the plot, and distance between rows. To obtain stable, precise loadcell readings the picker is stopped at the start and end of each plot, and at this time the driver sends an electronic tag to the micrologger for the purpose of data identification. An example of the data currently collected is shown in Fig. 3. This form of data collection fulfills our current needs as required by our field experiment procedures.

For situations requiring continuous monitoring of yield, the micrologger calculates average values for loadcell outputs and accumulated distance at short time intervals, e.g. 10 seconds. A simple algorithm is used to calculate yield using the difference between two consecutive logs of average

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weights and accumulated distances, and the distance between rows (a fixed input). The result of this calculation (seedcotton yield) is displayed on the on-board computer screen on a real-time basis.

The current weight/distance measuring system has been extensively and successfully used from 1995 to 1998 seasons for measuring yield of near 1000 cotton plots planted in our experimental farm in Uvalde.

In 1998, the computerized harvester was also used in experimental plots planted at the King Ranch in Kingsville, TX. A sample seedcotton yield map obtained with the picker's weighing measuring system is shown in Fig. 4.

Development of a New System for Real-time Measurement of Cotton Yield

While recognizing that the measuring system described above is perhaps the most accurate tool we can use for real-time measurement of seed cotton yield, it is also recognized to be of low practical value for commercial purposes. A new retrofitable sensor for real-time monitoring of cotton yield has been in development since the end of the 1997 season.

Acknowledgment

The following TAES-Uvalde personnel were involved in the construction of the weighing basket and distance measuring device: Mike Jett, Sixto Silva, Raymond Schawe, and Todd Foutz.

Figure 1. John Deere 299 cotton picker (top) and Allis Chalmer 860 broadcast-header stripper (bottom) modified with computerized system for direct measurement of seedcotton yield.

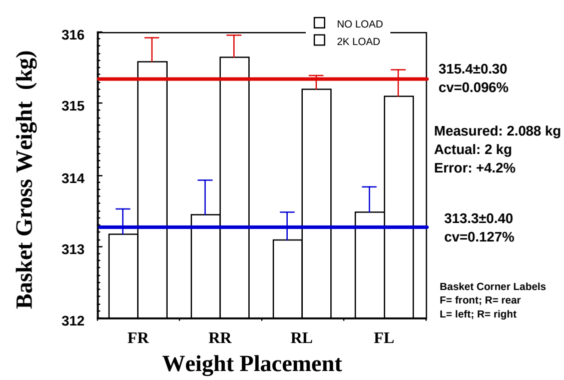

Figure 2. Weighing response to a 2 kg mass placed at each of the four corners of the inner basket. Vertical lines on top of columns represent standard deviations. Horizontal lines across columns represent average of no-load and 2kg-load measurements.

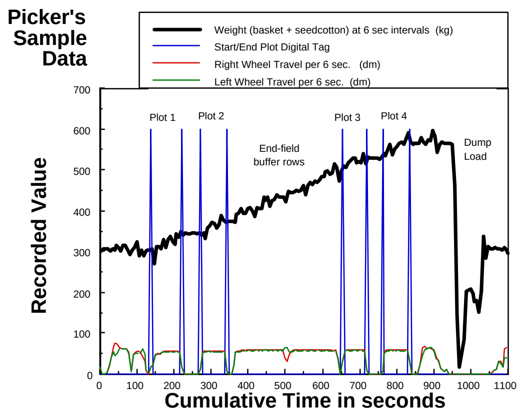

Figure 3. Graphical example of data collection during plot harvesting in Uvalde, TX.

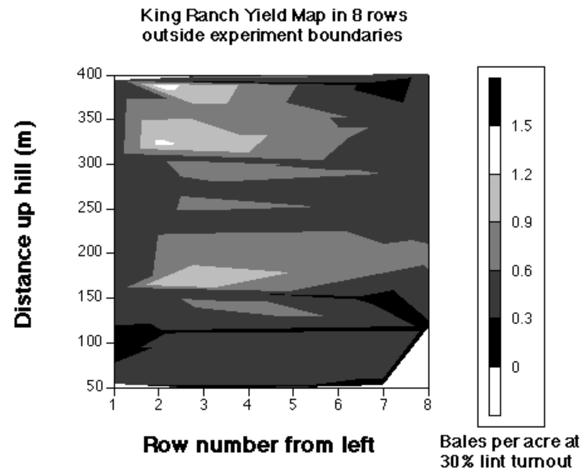

Figure 4. Seedcotton yield map example made with data measured at the King Ranch, Kingsville, TX with the computerized picker's weighing system.