Design and Evaluation of a Windrowing Corn Head for Stover Harvest

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Thesis submitted in partial fulfillment of

the requirements for the degree of

Masters of Science

(Biological Systems Engineering)

at the

UNIVERSITY OF WISCONSIN – MADISON

2011

Abstract

Previous research has shown the advantages of harvesting corn stover by forming windrows of stover at the time of grain harvest. However the modified corn head used in the previous research to accomplish windrow formation had performance limitations and was not commercially viable. To overcome the identified limitations, a new windrowing corn head was developed to improve the performance of the two-pass corn stover harvesting system. In conventional corn stover harvest, the combine distributes the stover back onto the ground, so harvest typically requires three additional operations: shredding, raking and finally harvest. The modified corn head described here forms a uniform, well structured windrow at the time of grain harvest, so the only additional operation is harvest by baling or chopping.

The windrowing device described in this thesis was designed as an attachment for a John Deere StalkMaster™ stalk chopping corn head. The modifications conveyed the chopped corn stover particles to the center of the head where they were deposited in a well structured windrow. The combine then straddled the windrow and the cob and husk fraction was strategically placed on top of the formed stalk windrow. The windrowing attachment at the corn head was divided into two sections: (a) gathering the stover from the stalk chopping knives, and (b) converging the chopped material into a windrow. Gathering methods tested included shields, tunnels and platforms. The converging methods tested included belt conveyors and augers.

Multiple design iterations and field tests of the various windrowing attachments led to a design that combined the gathering and converging processes into one process by mounting a pair of belt conveyors under the corn head. Due to the proximity of the conveyors in

relation to the ground, the conveyor mounts were designed to incorporate a hydraulically actuated protection system that would allow them to swing out of the way when an obstruction was encountered and be repositioned upon passing the obstruction. This hydraulic system also allowed the operator to position the conveyors in either “no capture” or “trailer” modes. The “no capture” mode prevented windrow formation by distributing the chopped stover back onto the ground when stover windrows were not desired. The “trailer” mode allowed the head with the windrowing attachment to be placed safely on a head transport cart.

Evaluation of the windrowing attachment’s performance showed that 63.8% of the theoretical stover yield could be harvested compared to 49.3% with a conventional multiple pass system. The total energy rich cob fraction lost during harvest decreased from 655 to 71 kg DM/ha. Ash content of the harvested stover also decreased from 16.4% to 7.6%. Compared to the previous two-pass windrowing corn head, the new design reduced specific fuel consumption from 0.50 to 0.37 L-hr/ha.