TWO-PASS CONTINUOUS ROUND BALING SYSTEM FOR BIOMASS FEEDSTOCKS

By

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ABSTRACT

Interest in reducing the United States' reliance on finite crude oil and decreasing greenhouse gas emissions have led to the development of commercial ethanol production from cellulosic biomass feedstocks. Cellulosic feedstocks, like small grain and soybean straw, sugarcane residue and bagasse, cotton stalks, corn stover, and perennial grasses are in great supply, but economically harvesting and transporting these materials presents a substantial challenge.

To address this issue, Hillco Technologies Inc., working with researchers at the University of Wisconsin – Madison, has developed a Single-pass Round Baling (SPB) system capable of forming round bales continuously from crop residues exiting the rear of the combine. This system utilizes an accumulating hopper that collects material as the baler wraps and ejects the previous bale. This SPB is an effective biomass harvesting alternative, but coupling grain and stover decreases the timeliness of grain harvest, which becomes a significant issue in seasons with a short harvest window. Additionally, wet conditions can leave the residues at unacceptable moisture contents at the time of grain harvest. A new system utilizing the same accumulating hopper and baler was developed to decouple these harvests and utilize the SPB hopper-baler for different types of cellulosic feedstocks.

This new system, called the Pull-Type Single-pass Baler (PTSPB) is tractor driven and includes a 1.8 m wide flail harvester pickup that is more robust than conventional baler pickups and also performs considerable size-reduction during harvest. Several alternatives were considered regarding the attachment of the harvester and ultimately the hopper-baler was towed behind the three-point mounted flail harvester. This machine was evaluated in

wheat straw and corn stover following grain harvest with a combine harvester in a two-pass continuous round baling system. The PTSPB successfully harvested standing and windrowed stover. Bales formed with the PTSPB following shredding and windrowing yielded 0.5-1.0 Mg ha^{-1} less than those conventionally baled. Direct harvest of standing stover resulted in a yield 2.0 Mg ha^{-1} greater than conventionally shredded and baled stover. The machine was also evaluated in both windrowed and standing perennial grasses in a two-pass and single-pass system, respectively. Continuous harvesting and round bale formation was successful, but at a low mass-flow-rate of 9.0 Mg h^{-1}.

The PTSPB concept has been successfully demonstrated and has shown sufficient promise that additional research is suggested to develop and evaluate the use of a wider flail harvester with a larger hopper optimized for greater feed rates. This improved machine should be evaluated extensively in standing corn stover and grasses to compare with existing biomass harvesting technologies.


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