

# Research aims for more efficiency in harvest and handling

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Kevin Shinnars wants farmers to put less energy into harvesting and handling biofuel crops - less fuel, less time and less labor. As a field machinery specialist, Shinnars has worked to improve the efficiency of harvesting forage for animals. Harvesting biomass crops poses similar challenges, he says.

"The biggest problem is there are way too many operations in the field," says Shinnars, a professor of biological systems engineering and mechanical engineering at the University of Wisconsin-Madison. "Every time we handle this material, it costs real money."

Much of Shinnars' research to date has focused on corn stover, the stalks and leaves left behind when grain is harvested. He has also embarked on a similar line of research on cost-effective harvesting of forage grasses, such as switchgrass, for both feed and fuel production.

Corn stover is usually left in the field or used as animal fodder, but it has tremendous potential as a cellulosic source of ethanol - if the shredding, drying, raking, baling and transporting can be made less costly and less labor-intensive.

The U.S. Department of Energy predicts that this type of biomass will sell for \$30-\$40 per ton. Although this price is low compared to high-quality alfalfa, which can sell for \$100-\$120 per ton, the high-value corn grain provides stover with a valuable co-product, he notes.

Shinners' goal is to develop a one-pass system that would simultaneously harvest corn and stover, while leaving enough residue on the ground to curb erosion and maintain tilth.

"Our approach has been to never let the [corn stover] hit the ground," Shinners says. "You try to drive cost down by eliminating all of those extra field operations, and don't worry about drying it."

One key to controlling costs is to make use of equipment that farmers already own. Shinners' stover-harvesting system makes use of a standard grain combine with a modified header - the part at the front end that cuts and gathers the crop.

"If we can let farmer continue to use the machine for harvesting wheat and oats and soybeans, they can dilute the cost of that machine across many operations and crops," Shinners adds. "It will make the cost of harvesting corn stover more viable than if there were a (single-purpose) corn stover harvesting machine." Harvesting grain and stover in the same pass not only makes more economic sense than going back for the stover later; it also prevents the contamination of stover with soil, which could foul things up at the biorefinery.

Once the corn stover makes it to the biorefinery, pretreatment is often needed to break the material down further, Shinners says. But, it can be quite costly at this stage, where high pressure and high temperature environments are used to speed the process.

Farmers may be able to pre-treat the corn stover themselves, right on their farm. The idea is a new one, but it has tremendous potential.

The wet corn stover in silos could provide a great opportunity for producers to add value at the farm level, Shinners says. "We're trying to determine what pretreatments would work on a farm scale, something

that a farmer could manage well. We see it as a good way to add value for the producer, and maybe make the biorefinery more efficient as well. We've got months to do these things, not 15 minutes like in a biorefinery."

An additional challenge to making corn stover a viable source of biomass energy is figuring out what fraction of the stover - leaves, husks, cobs and stalks - the biorefinery wants. Shinnars is confident that his team can modify a combine header to separate the stover any number of ways to meet a product specification from the processors.

The best way to perfect this process, Shinnars stresses, is to have a robust facility that can handle many types of biomass.

"Until then, we're working on all different ways of harvesting, handling, processing and storing this material right up to the biorefinery gate. Hopefully, we'll drive the cost down and add enough value so that we can make this work for everybody."

Source: University of Wisconsin-Madison

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