Research At Illinois Modifies Existing Equipment For Use In Harvesting Biomass

URBANA, ILL.

Researchers at the University of Illinois are making progress in the continual effort to develop sustainable and cost-effective processes for harvesting and collecting biomass feedstock. Alan Hansen, a professor in agricultural and biological engineering (ABE) at the University of Illinois, is part of a team working with the Energy Biosciences Institute (EBI) to determine the main obstacles in current processes and equipment that could limit their application in biomass feedstock harvesting.

"Part of our work is to assess how well existing equipment functions and what modifications we need to make to this equipment to ensure that it can handle miscanthus harvesting adequately," said Hansen. "These machines are generally set up to harvest crops like hay and forage. There is some degree of uncertainty related to these machines working in miscanthus, which is a much denser, taller crop, or even switchgrass, a shorter grass."

Harvesting traditional crops is generally a two-pass process, said Hansen. The mower/conditioner cuts the crop, feeds it to a set of rolls that crimp and mash the cut material, and then lays it on the ground in windrows. The baler makes a second pass to pick up and bale the material.

"In some of our earlier work with miscanthus, the mower/conditioner was not set up well," said Hansen, "so after the miscanthus stems were cut, instead of being mashed up, they came straight out the back, all lined up, and it was difficult for the baler to pick up that material."

Hansen said they experimented with a sickle mower as well as a disk mower. "We eventually chose the disk mower because the through-put is much greater," he said. "But there were challenges with that in that you have an auger that propels all the cut material to the center of the head to then feed it out the back. The auger wasn't doing a very good job of picking up these long stems after they were cut. So they had to add some fingers and vanes to help with that process. They also changed the size of the auger in order to help propel the material more efficiently into the center of the machine."

After the changes were made, "The system seemed to work well, but we haven't had a solid opportunity to evaluate the performance," Hansen said, "so we will be able to do that in the coming harvesting season."

Hansen said there are data-logging systems fitted to the mower/conditioner in order to track its performance in the field. "We use GPS to capture information about the instantaneous location of the machine; we can also monitor how much power is being used, how fast the machine is going, how the engine is performing, things that allow us to evaluate how effective the machine is at harvesting the biomass," he said.

The researchers also collect data on the baler. "Ultimately, we would like to know, for each bale that is generated, the weight of the bale and where it ends up being placed in the field," said Hansen. "We can then use that as a basis to map the yield."

Hansen said the team is currently exploring the development of what he called a "look-ahead" sensor. "When an operator runs a machine through the field, they have to set the speed based on their judgment about the amount of biomass there is ahead of the machine," he said. "It takes a couple of runs to get a sense of what that is. If we can judge the size and density of a plant – and thus the yield – we can provide that information to the operator, who can then adjust the speed of the machine. And beyond that, we can use it as a basis of automatically controlling the speed of the machine.

"We've done some field trials, not on the machine per se, but stationary trials, where we look ahead at the crop and do an assessment. So this could be a very useful sensor," he concluded. "It looks promising."

This study, "Harvesting biomass feedstock as a source for energy," was presented by Phillip Johnson at the American Society of Agricultural and Biological Engineers Annual International Meeting in Louisville, Kentucky in August 2011. Researchers who contributed to the study include Hansen, Johnson, Sunil Mathanker, Clairmont Clementson, Zewei Miao, and Tony Grift, faculty in the Department of ABE and members of the Energy Biosciences Institute in the Institute for Genomic Biology at the University of Illinois

The Energy Biosciences Institute is a public-private collaboration in which bioscience and biological techniques are being applied to help solve the global energy challenge. The partnership, funded with $500 million for 10 years from the energy company BP, includes researchers from UC Berkeley, the University of Illinois, and the Lawrence Berkeley National Laboratory. Details about the EBI can be found at www.energybiosciencesinstitute.org. Δ