Optimizing the Use of a John Deere Bundling Unit in a Southern Logging System

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Abstract

With the current energy crisis and with petroleum prices skyrocketing, all sources of alternative fuels need to be explored. John Deere's Biomass Bundler unit is an effective machine for harvesting forest residues, which can be used as a source of fuel wood and/or a feedstock for bio-fuel production. This project aims to explore an avenue that could supply a very promising source of readily available energy in Southeastern forested lands. Typical, southern harvesting operations consist of whole tree harvesting in which trees are felled, and then skidded to a landing. Limbs and tops are usually either deposited over the landscape or piled in wind rows. The biomass bundler will serve to capture the otherwise non merchantable material and maximize the marketability of the entire tree. In order to reduce costs, maximize efficiency, and implement the bundler in a tree length harvesting operation, this project will test a prototype harvesting system. The objectives of this venture are to: a) adapt the John Deere B380 bundler unit to a motorized trailer; b) design the optimum deck configuration; and c) conduct a productivity study of the bundler unit.

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Introduction

With instability surrounding the price and source of imported energy streams, our focus has been drawn to markets on the home front. Nearly 370 million dry tons of biomass is available annually on a sustainable basis from forest-derived resources in the United States (Perlack et al 2005). Such huge avenues of untapped energy in the US have been brought to light in recent days and harvesting equipment for this material must be made available. Although technologies and markets for such innovative practices have not yet matured, this project aims to explore a system that could supply a very promising source of readily available energy in Southeastern forested lands.

John Deere's B380 bundling unit is an effective machine for harvesting forest residues. In order to fully utilize forest resources, all available material must be captured. Typically, southern harvesting operations consist of whole tree harvesting in which trees are felled with a feller-buncher, then skidded to a landing using a grapple skidder. Limbs and tops are removed from the tree at the deck. The addition of a bundler in a southern logging system would condense the otherwise unused slash material and create a merchantable product.

Chipping vs. Bundling

Chipping is an alternative way to increase the utilization of the whole tree; however, bundling has some inherent advantages over chipping. Bundles provide consuming plants with more overall versatility in their processing. Slash bundles have more air space which enable them to air dry much more than chips in inventory. With most of the consuming plants desiring fairly dry material, air drying can lower the moisture content without any additional cost. Although the outer edges of a chip pile dry significantly, the inner portion of the pile remains at rather high moisture content. Within one month, bundles can lower their moisture content by 10 to 25% moisture content without any input (Patterson 2008). According to an energy content equation, the loss of moisture content through evaporation in the bundles causes a 12-

28% increase in energy content per unit volume (Karha 2006). The moisture content, size, and shape of the material can be made uniform through processing at the mill.

In order to produce a compressed residue log, slash is fed into the B380's four compression feed rollers. Two compression arms then further compress the slash while sliding the bundle forward. A rotating twine magazine then fastens the bundles with bailing twine. At a predetermined length, the automated cutting saw severs the compressed slash resulting in a slash bundle sometimes referred to as a compressed residue log (CRL) (Martin 2008). In order to reduce costs, maximize efficiency, and implement the bundler in a tree length harvesting operation, this project will test a prototype harvesting system. The objectives of this venture are to: a) adapt the John Deere B380 bundler unit to a motorized trailer; b) design the optimum deck configuration; and c) conduct a productivity study of the trailer-mounted bundler unit.

Figure 1. Trailer-mounted B380 bundling unit.

The prototype configuration (Figure 1), consisting of the bundler mounted on the motorized trailer, will potentially require less capital investment than both the forwarder mounted 1490D slash bundler, and in-woods chipping operations. Replacing the forwarder with a motorized trailer will, without question, cut down on the cost of the unit. The prototype biomass bundling unit will require a very similar amount of initial investment as a chipper; however, the bundling unit will consume less fuel than most in-woods chipper, and the bundles can be transported by customary log trailers. The use of ordinary log trailers will cut costs as well as create less deck crowding.

Prototype Bundler Research

In order to adapt the bundling unit to a motorized trailer, the hydraulic and power demands were satisfied by a Cutting Systems Inc. (CSI) motorized trailer. The trailer is equipped with a 102hp John Deere engine and a variable displacement pump rated at 52 gal/min of flow at 3500 psi. A 24 volt power supply mounted within the trailer supplies the electrical components with power. The mounting configuration was adopted from the current 1490D slash bundler. The unit is fastened to a rail system that is welded to the trailer (Figure 2&3).

Figure 2. Side view of the mounting brackets.

Figure 3. The bundler is fixed to the trailer using two 4" steel tubes.

The optimal deck configuration for implementing the trailer mounted bundler is under investigation. Figure 4 is a conceptual view of a potential deck layout in which a trailer mounted bundling unit could be implemented. The bundler must not interfere with the harvest system's more lucrative round wood production. Skidders that would normally carry the slash away from the delimber would simply tote the slash within reach of the designated loader. The loader would then feed the bundler and stage the bundles for the next trailer amid lulls in log loading duties.

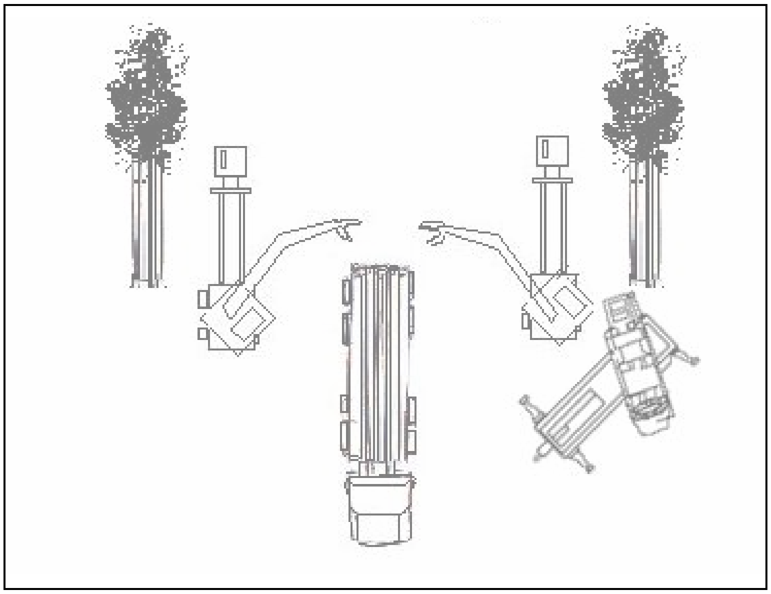

Figure 4. Conceptual deck configuration

Initial production estimates from the prototype model range from 10-40 bundles per hour. Some of the inconsistencies stem from slash orientation, quality, and size, as well as loader and bundler operator inexperience. Past studies on the forwarder-mounted bundler show varying results. The USDA Forest Service performed an operational performance analysis of the slash bundler in Idaho, Oregon, Montana, and California. The Forest Service's main goal was to reduce fuel levels on the lands to thwart the threat of wildfires. Material bundled ranged from logging slash to small diameter trees. In Idaho City, Idaho, with large amounts of readily available slash, the bundler averaged twenty-four bundles per hour. Production levels ranged from five to twenty-four bundles per hour depending on the sites slash density and slash arrangement (Rummer 2004).

Another study of the 1490D Slash Bundler was performed in Arkansas by members of the Forest Products Society (Patterson 2008). The analysis consisted of four case studies performed on four different sites. Each of the sites underwent a different harvest regime. The first site consisted of a mature stand of loblolly pine clear cut harvested by conventional logging equipment. Logging residue was piled along the roadside to increase accessibility. The slash bundler produced 22.3 bundles per hour with an average cycle time of 2.69 minutes. Site 2 was a twenty-six year old stand of pine plantation undergoing a second thinning by the same harvesting system. Limbs and tops were piled at the deck and the slash bundler was able to produce more than 31 bundles per hour. Site 3, a stand of eleven year old loblolly pine plantation, produced 36.1 bundles per hour.

The fourth site in the study was a thinning operation in seventeen year old loblolly pine plantation. Cut-to-length harvesting equipment was utilized on the site which meant that the 1490D had to travel in-woods to gather material. The resulting 13.8 bundles per hour reflect the operational differences. The average weight of the bundles for sites one through four are 883, 916, 950, and 957 lbs (Patterson 2008).

John Deere published numbers in a presentation of a study done in France showing 2006 production numbers. Study conditions are unknown, but the France study reported eighteen to twenty-five bundles per hour was feasible with the 1490D. An aside was made that these production rates could be achieved with an experienced operator and appropriate site planning (Martin 2008).

Future Research

Continued production research will culminate in a time and motion study of a clear cut operation. Data will be collected on the harvesting system before and after implementing a trailer mounted bundling unit to determine the effects and estimate production levels. Stand data will be gathered to identify characteristics that may affect utilization and overall production. A recommended deck configuration will be determined and all results will be published.

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