Determining the Impact of Felling Method and Season of Year on Coppice Regeneration

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Abstract

There is an increasing interest in the establishment of plantations in the Southeast region with the objective of producing biomass for energy and fuel. Establishment of these plantations will require the development of a feasible way to harvest them. These types of plantations are called Short Rotation Woody Crops (SRWC). Popular SRWC species are Eucalypt (*Eucalyptus spp.*), Cottonwood (*Populus deltoids*) and Black Willow (*Salix spp.*). These species have in common strong growth rates, the capability to adapt to several weather conditions, the ability to coppice (generation of new stems after harvest) and rotations of 2-5 years. SRWC have generated interest to many forest products companies and timber producers in the Southeast region in the last few years. Although they are a big promise to the bioenergy market, there are still several concerns about the best way to harvest them without damaging their ability to coppice and when is the best season to harvest them so the sprouts regrow. Plots were installed at several locations in Florida, Mississippi and Arkansas. The plots were cut using a typical shear-head feller-buncher and a chainsaw; also two harvest seasons were scheduled: winter and summer. Each plot was divided in 4 treatments: winter-shear, winter-saw, summer-shear and summer-saw. Winter harvest occurred in December and March, while summer harvest occurred in May and June. Plots will be evaluated for mortality of the stumps and the number of stems regenerated.

Keywords: Biomass, Bioenergy, Short rotation woody crops, Eucalypt, Cottonwood

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Introduction

There is an increasing interest in finding different alternatives to produce fuel and energy in the U.S. The continuous population increment and the dependence on foreign oil make the production of biofuels and bioenergy from biomass very attractive. Furthermore, according to Gonzalez et al., 2010, the U.S. Energy Secretary proposed the replacement of almost 30% of ground transportation fuel by some type of alternative clean energy by the year 2030.

Short Rotation Woody Crops (SRWC) are defined as plantations established to grow biomass to produce biofuel and bioenergy. Due to the recent concerns about the fuel and energy replacement, and also the development of several bioenergy and biofuels mills in the Southeast region, several companies, universities and private landowners have been encouraged to research the SRWC area and even to start planting SRWC at commercial scale.

There are several SRWC species already being used in U.S., such as Cottonwood (*Populus deltoides*) and Black Willow (*Salix spp.*), which are native species and adapted to the Southeast region. Also, the introduction of the Eucalypt (*Eucalyptus spp.*), which is one of the most planted species in the world, is being tested in parts of the U.S. These species have in common strong growth rates, rotations between 2 and 6 years and coppicing ability. The coppicing, which can be defined as the ability a tree has to generate new stems from the stump after the harvest, is one of the most important characteristics of SRWC; since it will allow using the same plantation for up to 5 rotations, without the need of establishing a new one, and thus reducing the costs. The establishment of these plantations is on-going, but there is still concern on how to efficiently harvest them and maximize the utilization of the coppiced stems.

The equipment designed to harvest SRWC already exist and they are common in Europe, but have high capital costs. Such an investment wouldn't be justified for a developing market like SRWC is in U.S. According to Langholtz et al., 2011, this equipment is designed to harvest dense plantations and materials between 2 and 10 centimeters.

Crist et al., 1983, compared the effect of harvesting method (shear-head and chainsaw) on the ability to coppice *Populus spp.*in Wisconsin; they concluded that neither the chainsaw nor the shear-head significantly affected coppicing as long as the stumps were not excessively damaged during the original harvest. The most popular harvesting system used in southeastern U.S. is the circular saw-head feller-buncher, which has been extensively used to harvest Eucalypt in South America. However, it is used in plantations intended for pulp and paper and there are no concerns about the possible effects it has on the coppicing ability. On the other hand, the shear-head feller-buncher has considerable lower maintenance and capital costs compared to the saw-head. However, this equipment is used to harvest trees with larger diameters (>15 centimeters) and in plantations intended for pulp, paper and sawtimber markets.

There are also several doubts about the effect of the season of year in which the harvest is done on the ability to coppice with these species. Theories indicate that harvesting during dormant season (winter) will result in more coppiced stems, restricting the harvest only for that

season. Ducrey and Turrel (1992) found that, after harvesting every 2 months for a 1 year period, the stumps of Holm Oak (*Qercus ilex* L) harvested during dormant season resulted in minimum stool mortality, and maximum new sprout number, height, and diameter growth. However, this study was performed in France, which has different weather conditions, and with different coppicing species than those that are commonly used in U.S.

Project Description

As previously mentioned, there are uncertainties about the most adequate method to harvest SRWC in the U.S. due to the absence of equipment designed to harvest these plantations and when is the best season to harvest them. For these reasons, this project has the following objectives: (a) compare the effects of felling methods used in short rotation woody biomass plantations on its ability to coppice, and (b) determine if the ability to coppice may be affected by the season of year in which the harvest is done.

The project consists of six one acre size study sites. Two sites are located in Fort Pierce, at Evans Properties, and Sebring, FL, and are planted with *Eucalyptus urograndis*, two and three year old, respectively. A 6 year old *Eucalyptus grandis* site is located in Venus, FL. One site is located in Little Rock, AR, and consists of a *Populus deltoides* plantation that is three years old. The remaining two sites are located in Greenville, MS, and are planted with *Populus deltoides* and *Salix spp*, both five years old. Each plot was divided so they consist of four different treatments: shear-winter, saw-winter, shear-summer, and saw-summer.

The felling methods used on the project were a shear-head mounted on a skid steer (Figure 1) and a chainsaw to simulate the effect of the circular saw-head on a feller-buncher. Depending on the topography of the site and the layout of the plantation, the felling method treatment was established in alternating rows, to avoid possible site and soil effects; however, due to the small size of the plots, site and soil effects would not be a problem, hence if it wasn't possible to alternate rows, the plot was divided in identical size for each treatment.

Figure 1. Shear-head mounted on skid steer.

Each plot was divided in two equal size plots for the season treatment. The winter harvest was performed during December 2013 in the two Eucalypt sites in Florida, and during March 2014 in the Black Willow and Cottonwood sites in Arkansas and Mississippi. The summer harvest in the Florida sites will occur during May 2014 and in June 2014 in the Arkansas and Mississippi sites.

After each harvest an evaluation of bark damage on the stumps is performed. Depending on the site and the species the bark damage varies, it also varies among the equipment used. Bark damage may be important, since it may have an effect on the coppicing ability, as Crist et al., 1983, determined in their study. For this study the bark damage of the stumps was classified in five categories: (0) no bark damage, (1) bark damage between 1 – 25%, (2) bark damage between 26 – 50%, (3) bark damage between 51 – 75%, (4) 75% or more bark damage (Figure 2).

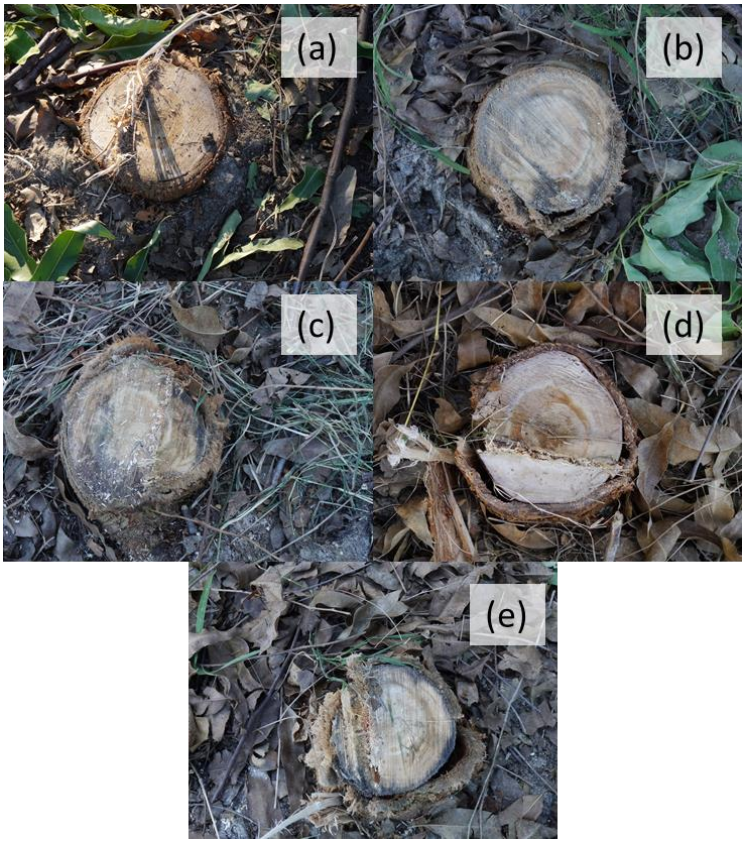

Figure 2. Bark damage classification: (a) 0%, (b) 1-25%, (c) 26-50%, (d) 51-75%, (e) >75%

The results of the project will be determined depending on the number of stems regenerated. Difference in number of stems will be determined between harvesting methods and season of year.

Preliminary Results

The preliminary results, with data obtained at the Evans Properties and Venus sites indicate that stumps cut with chainsaw tend to coppice 5% more than stumps cut with shear head (Figure 3) and that stumps cut with chainsaw generated 1 new sprout per stump more than stumps cut with shear head. Also, bark damage has an effect on the stump's ability to coppice: while 100% of the stumps with bark damage class 0 coppiced, only 89% of the stumps with bark damage class 4 coppiced (Figure 4).

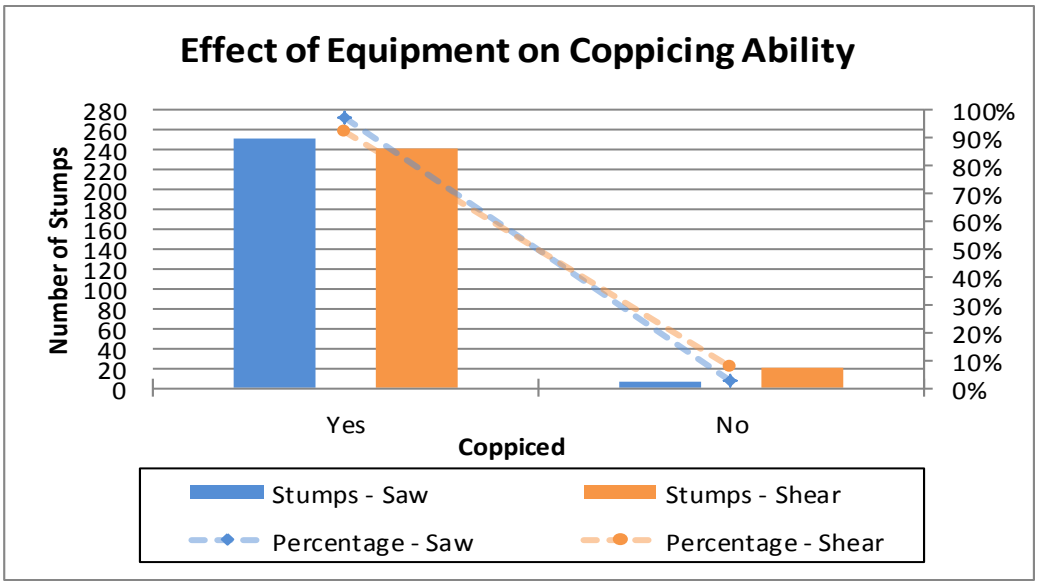

Figure 3. Effect of equipment on stump's ability to coppice.

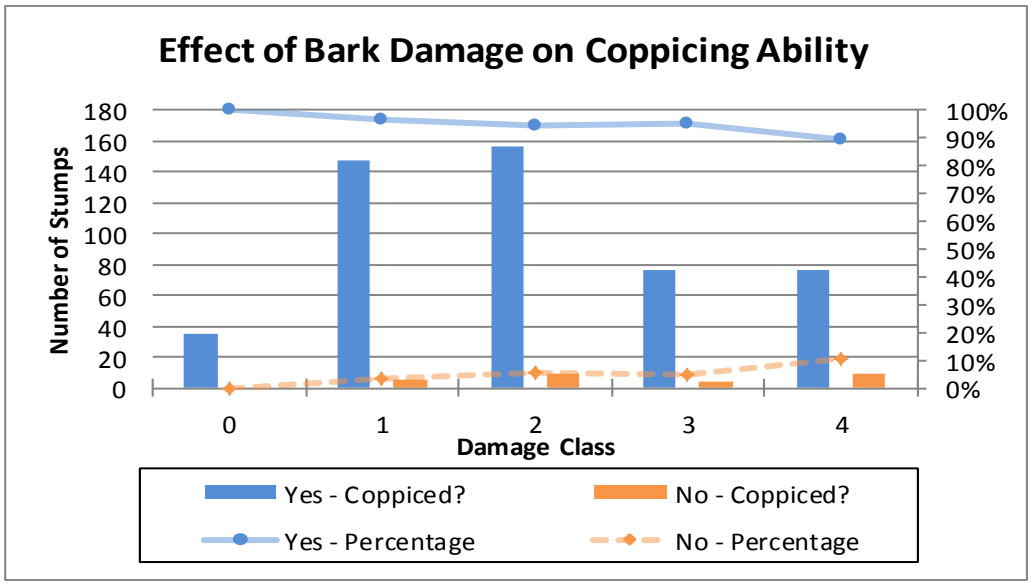

Figure 4. Effect of Bark damage on stump's ability to coppice.

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