Track #1 - Published Abstract

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Productivity of large site prep tractors for fire line establishment

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Mastication of biomass using a variety of equipment types has been studied as a method to decrease fuel loading and reduce ladder fuels to control the spread of wildfires and as pre-treatment for the re-introduction of prescribed fire. In the US south carefully planned prescribed burns are used to manage southern pine forests, as wildfires are a significant financial risk. Fire lines to manage prescribed burning have traditionally been established with small crawler dozers (10 t, 80 kW). Large wheeled mulchers may provide an alternative with equivalent costs, but offer increased flexibility with faster travel speeds between sites and reduced soil disturbance.

We used a 261 kW Caterpillar 586C site prep tractor with a Cat HM825 mulcher head (2.54 m cutting path) to apply 3 treatments: a slow treatment (0.8 km/h), fast treatment (1.2 km/h), and a 2 pass treatment at a fast speed (1.2 km/h or 1.6 km/h). Treatments were applied on a level site with clay soils, a gently sloping site with loamy soils, and a gently sloping site with sandy loam soils and a high incidence of surface sandstone. The order of the treatments was selected randomly in a block of the 3 treatments. In mature thinned stands, blocks were located in similar conditions, such as take rows (rows of trees removed for access during a previous thinning) or areas of low stand density, which allowed the machine to maneuver. In clearcuts or young regeneration (0 to 6 years since clearcut) the blocks were located on the stand perimeter.

The disturbed area from single pass treatments was about 3 meters wide, and the width of double pass treatments averaged 3.6 meters. Most of the fire line surface for all three treatments had mineral soil exposure across the full width. Double pass treatments had the highest mineral soil exposure (66-90%), with the slow and fast single pass treatments ranging from 55-80%. Skips in the lines were typically due to sudden changes in terrain or obstacles, such as dips, rises, rocks, or stumps. Retreatment of skips caused delay time and lowered treatment speeds. In general we were able to maintain the target speeds with less than 10 percent delay, but were unable to maintain the 1.6 km/h speed on the gently sloping sites. The ANOVA of travel speed by treatment, site, stand type, and two-way interactions was significant ($F=1.775$, $P= 0.0822$). However, only treatment was significant ($F=8.715$, $P= 0.0007$). Slow (0.98 km/hr) and double pass (0.91 km/hr) treatments were statistically similar, and the fast single pass productivity averaged 0.32 km/hr faster. Since the double pass treatment had similar productivity but greater mineral soil exposure and increased fire line width, it appeared to be the most feasible option. Mulched fire line costs ($/km) for the slow and double pass treatments are likely greater than the cost for dozed fire line. However, mulcher productivity (km/hr) could be twice that of the dozer in mature woodlands or young stands where the mulcher can easily navigate.

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