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TECHNICAL RELEASE

14-R-7

CHIPPING AND GRINDING PRODUCTION RATE CALCULATOR

Production: measurement *May 2014*

INTRODUCTION: Authors publish machine production studies in journal articles or conference proceedings that are often difficult to access, let alone compile. To improve the availability of data from production studies of chippers and grinders, we compiled relevant data and made them available through a web interface: **http://auburn.edu/chipRateCalc.**

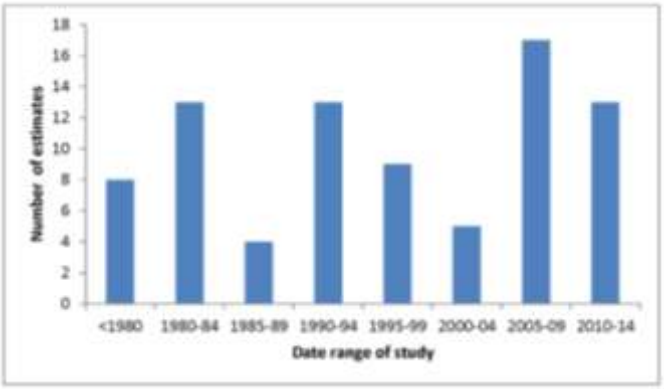

Fig. 1: *Date range of chipping and grinding production estimates included in the web calculator.*

GENERAL FEATURES: The data for individual chipper and grinder production estimates were recorded with all the attributes available. If a study provided more than one production estimate and there was sufficient detail to describe each estimate, we entered multiple production estimates. Currently there are 31 studies and 84 production estimates. The data sources cover published results of chipping and grinding studies in North America for machine makes and models typically available across North America. The reference list is available on the web site. ***Figs. 1, 2, and 3*** summarize some data attributes.

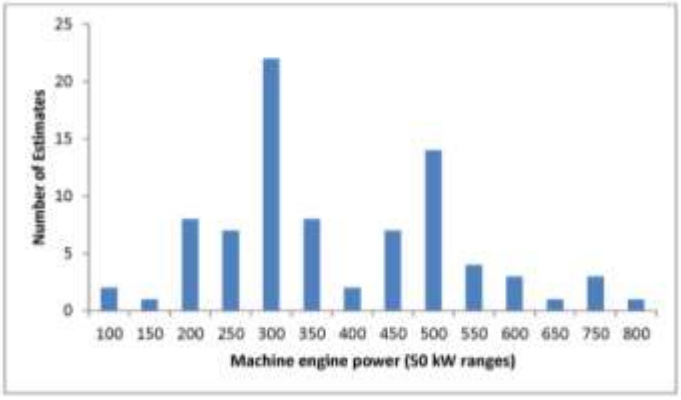

Fig. 2: *Engine power range of chipping and grinding production for estimates included in the web calculator.*

Dates represent the date of studies' publication (***Fig. 1***). Usually the machine model year was somewhat older than the publication date since there was often over a year between measurement and publication. Most publications did not give the machine model year. The engine power range represents the engine powering the drum or disc (***Fig. 2***). One kilowatt equals 1.34 hp. Some of the older disc chippers in the studies had a machine with a second engine that operated other machine components. The ranges in production rate and engine power are presented in ***Fig. 3***. The trend lines are presented for information only; a more thorough model of chipping productivity was presented by Spinelli and Hartsough (2001)[1].

[1] Spinelli, R. and Hartsough, B., 2001. A survey of Italian chipping operations. Biomass & Bioenergy, 21(6): 433-444.

The production rate is in English tons per productive machine hour (tons/PMH). For 31 of the estimates, moisture content (MC) was not available in the published results. If material was felled within one day of processing, we recorded MC as 50% (wet basis), within 1-40 days as 44%, and more than 40 days as 34%. These estimates were derived from an average of the study data for which both material age and moisture content were available. If the user selects the material age and moisture content "as measured," the production rate would be for material in that age range regardless of moisture content. We calculated production rates for green (50%) and dry (0%) moisture contents using actual or estimated moisture contents.

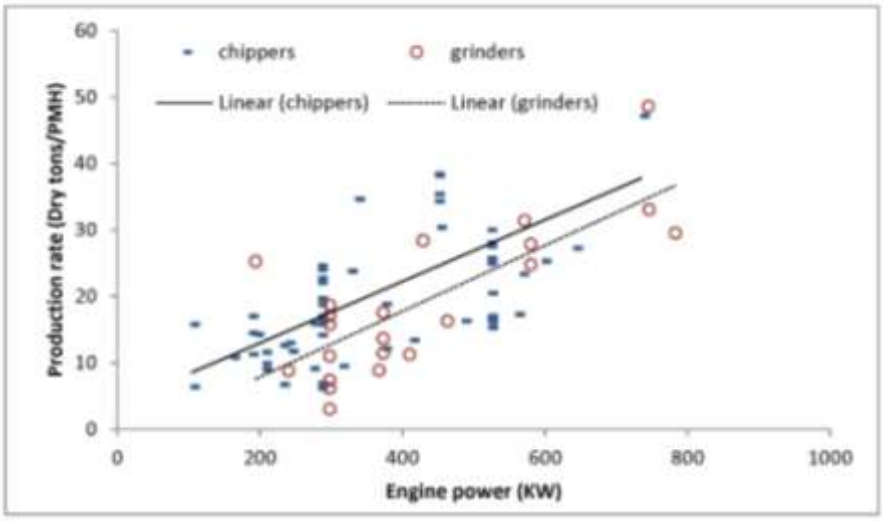

Fig. 3: *Individual chipping and grinding production estimates (dry tons per productive machine hour) by engine power.*

Other options narrow the results by machine type, material type, and study length. Increasing the number of options will reduce the sample size used to determine the production rate. The calculator presents the user with the mean, median, the first and the third quartiles from the sample distribution, and the number of samples in the selection.

APPLICATION: Here is an example of using the calculator for determining the production rate of a 350 kW machine (range 300-400 kW) to produce chips (Moisture "as measured" and Material age "green/fresh"). There are 7 samples with a mean production rate of 37.4 green tons per PMH. If Material type is limited to "trees," the production rate increases to 40.3, and the sample number is 6. Narrowing the power range to 50 kW (325-375) does not change the sample number or mean. Finally, changing the machine type to "all chippers" changes the mean to 49.7 and reduces the sample number to 3. The "all grinders" option also has 3 samples, with a mean of 30.9. The user can choose to narrow results to a small number of studies with more specific conditions or include fewer options to understand the variability of production estimates around a few general specifications.

The Forest Operations Unit of the Southern Research Station, USDA Forest Service supported this project. Citations for the production estimates from the calculator should be: *Smidt, M. F. and D. Mitchell. 2013. Chipping and grinding production rate calculator.*

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