NORTH CENTRAL FOREST EXPERIMENT STATION 1992 FOLWELL AVE. ST. PAUL, MN 55108 FOREST SERVICE-U.S.D.A.

Research Note NC-257

1980

ENERGY VALUES OF NINE *POPULUS* CLONES

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ABSTRACT.— Compares calorific values for components of nine *Populus* clones. The components include stem wood, stem bark, and branches. Also compares calorific values for clones of balsam poplar and black cottonwood parentages.

KEY WORDS: Calorific values, calorimetry, tree components, parentage

INTRODUCTION

Because of its rapid growth, *Populus* may be a desirable genus to grow for energy in short rotation intensively cultured plantations (Zavitkovski *et al.* 1976). Inadequate information is available on energy values for *Populus* clones selected for this study or the individual tree components of *Populus* clones. Parr and Davidson (1922), Peterson *et al.* (1970), Reiners (1972), and James and Smith (1978) reported calorific values for different components of native *Populus*. Holt and Murphey (1978) determined calorific values for *Populus* clone NE-388 and recently Bowersox *et al.* (1979) reported calorific values for seven hybrid poplars.

METHODS

One sample tree was randomly selected from each of nine, 4-year-old Populus clones grown at Rhinelander, Wisconsin. Each tree was divided into upper stem, lower stem, and branches. The bark was removed from the stem sections. All components were dried and ground in a Wiley mill to pass a 60-mesh screen. Ground samples were dried again at 70° C for at least 48 hours and pressed into pellets.

The calorific value (also called heat of combustion) of the samples was determined in an adiabatic oxygen bomb calorimeter using the standardized techniques of the manufacturer (Parr Instrument Company 1969[1]). Correction for fuse wire burn and heat of formation of nitric acid were deducted from the gross heat of combustion.

Analyses of variance and t-tests were used to test differences among clones and components. All tests were done at the 95 percent confidence level.

[1]*Mention of trade names of the product does not constitute endorsement by the USDA Forest Service.*

RESULTS

As shown below, mean calorific values of the *Populus* clones ranged from 4,636 to 4,755 cal/gm.

Clone[2]	Parentage	Mean cal/gm
5377	*P.* x *euramericana* cv. Wisconsin #5	4,636
5326	*P.* x *euramericana* cv. Eugenii	4,663
5331	*P. betulifolia* x *P.* trichocarpa, NE-229	4,680
5262	*P. candicans* x *P.* berolinensis, NE-383	4,688
5332	*P. betulifolia* x *P.* trichocarpa, NE-98	4,710
5263	*P. candicans* x *P.* berolinensis, NE-386	4,711
5272	*P. nigra* x *P.* laurifolia, NE-1	4,726
5260	*P. tristis* x *P. balsamifera*	4,730
5258	Unknown	4,755

Although significant differences cannot be tested, balsam poplar clones (5262, 5263, 5272, and 5260) tend to have higher unweighted mean calorific values than black cottonwood clones (5377, 5326, 5331, and 5332).

Mean values of individual tree components are shown in the following tabulation.

Component	Mean cal/gm
Lower stem bark	4,604a[3]
Lower stem wood	4,618a
Upper stem wood	4,703b
Upper stem bark	4,760bc
Branches	4,813c

The clones were separated into two groups, each having at least one identical parent and their calorific values were tested for significant differences using a t-test.

[2]*North Central Forest Experiment Station clone number.*

[3]*Means followed by the same letter are not significantly different at the 5 percent probability level.*

Component	Black poplar Cal/gm	Balsam poplar Cal/gm
Lower stem bark	4,572	4,604
Lower stem wood	4,628	4,612
Upper stem wood	4,709	4,693
Upper stem bark	4,674	4,825[4]
Branches	4,779	4,833[4]

Clone 5258 was excluded from this test because its parentage is unknown. Clones with balsam poplar as one parent had significantly higher calorific values than black poplar clones in the upper stem bark and branches. Although clones do not differ significantly, balsam poplars tend to have a higher calorific value than black poplars. One possible reason could be the higher extractive content in balsam poplar's buds and bark. Upper and lower stem wood and lower stem bark were not significantly different between the two groups.

DISCUSSION

Calorific values for stem wood in this study are similar to those presented by Holt and Murphey (1978) for bole wood of *Populus* clone NE-388, which ranged from 4,563 to 4,607 cal/gm, and to Bowersox *et al.* (1979) for composite wood and bark samples which averaged 4,659 cal/gm for seven *Populus* clones. Similarly, Peterson *et al.* (1970) reported calorific values of 4,591 cal/gm for trunk wood and bark of a *P. tremuloides* clone in Alberta. However, Parr and Davidson (1922) and Reiners (1972) found somewhat higher calorific values for bole wood—4,800 cal/gm for unspecified poplar wood, and 4,760 cal/gm for *P. grandidentata,* respectively.

Reiners (1972) also measured a mean calorific value of 4,800 cal/gm for branches, which agrees with the average for clones in this study. James and Smith (1978) separated twigs into bark and wood. The calorific value for twig wood was 4,550 cal/gm and that for twig bark was 5,040 cal/gm. The twig wood value is similar to my data for upper stem wood, but the twig bark value is higher than my value for upper stem bark.

In this study calorific values increased up the stem; branch calorific values were always higher than those of other components. This trend is substantiated by Madgwick (1970) and Hughes (1971).

[4]*Significantly different at the 5 percent level.*

I found that calorific values of wood samples did not differ significantly among clones. This agrees with Bowersox *et al.* (1979). Because stem wood is the largest component of the total tree (about 50 percent of the total weight), plantations at wider spacings may show differences due to their larger proportion of branches.

Calorific values of upper stem bark and of branches of clones with one balsam poplar parent were significantly higher than those of other components. Contradictory evidence was reported by Bowersox *et al.* (1979) for clone NE-388 whose one parent belongs to the balsam poplar group. However, the comparison was between a composite sample of bark from the total stem and wood, which would lower the calorific value for bark because bark from lower stem has a lower calorific value than bark from upper stem.

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ACKNOWLEDGMENT

I would like to thank J. Isebrands, M. Martin, H. Phipps, D. Riemenschneider, and J. Zavitkovski for their constructive reviews of the manuscript.

☆U.S. GOVERNMENT PRINTING OFFICE: 1980--668942/3