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EVALUATION OF HYBRID POPLAR CLONES UNDER INTENSIVE CULTIVATION FOR BIOMASS PRODUCTION IN QUÉBEC

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ABSTRACT

Three experimental plantations were established in 2012 at three sites in the *Bas-Saint-Laurent* and *Lac-Saint-Jean* regions to promote and demonstrate the short-rotation-intensive-culture (SRIC) hybrid poplar crop concept for biomass production. The general objective of this study was to evaluate already-available material for poplar plantations and new hybrid poplar clones, obtained from breeding at the *Direction de la recherche forestière*, for SRIC. Many performing clones from different hybrids with *Populus maximowiczii*, *P. nigra*, *P. trichocarpa*, *P. deltoides* (MxN, MxT, MxD, etc.) are already available for evaluation of their characteristics under various coppicing regimes. The plantations were established in collaboration with regional organizations involved in energy crops like *Osons l'Osier* and *Nutrinor* to compare coppicing ability and biomass yield among poplar clones. Preliminary growth results obtained after the first growing season are presented for several clones. Significant clone differences are expected in vigour, yield, and coppice regrowth after repeated rotations. Mechanical harvesting of the crop may also have a strong influence on resprouting and sustainability of the stools over repeated growth cycles.

Keywords: biomass production, hybrid poplar, clone selection, coppice, SRIC, *Populus* spp.

INTRODUCTION

After more than 40 years of breeding and testing, the Québec's hybrid poplar improvement program produced superior clonal populations selected for production of timber in plantations with 15 to 20-year rotations and density varying between 600 and 1 100 trees per hectare. Poplars could also be planted at close spacings (over 6 000 trees per ha) under short-rotation-intensive-culture (SRIC) to provision feedstock for energy industry (Geyer 2006, Di Matteo *et al.* 2012). Already-in-use varieties of hybrid poplars and new MT and MN clones, obtained through recent breeding operations, have to be evaluated for repeated coppice growth with short-rotation harvests. In Italy, new cultivars selected for SRIC regimes were more successful than traditional timber clones (Paris et al. 2011). Capacity to tolerate high stand density, high survival rates of sprouts and high yield over frequent and repeated coppicing, and suitability for mechanical harvesting were some of the important poplar characteristics to select for.

MATERIALS AND METHODS

Three tests and one regular plantation were established in May 2012 in Saint-Bruno d'Alma (*Lac-Saint-Jean* region), Saint-Paul-de-la-Croix and Cacouna (*Bas-Saint-Laurent* region) with 14 different clones cultivated under a SRIC cultural regime (Table 1). We used 25-cm long cuttings provided by the DGPSP (MRN) and produced in stoolbeds in Saint-Modeste and Normandin forest nurseries. Cuttings were mechanically planted at a density of 10 000 plants per ha (55 cm × 180 cm) for two tests in the *Bas-Saint-Laurent* region. At Saint-Bruno, plant density of the contiguous plantation, bordering the test on the same site, was 15 000 plants per ha (manual planting), except for the replicated test where four clones were planted at two densities (9 000 and 15 000 plants per ha) (Fig. 1). Pre-emergent herbicide (Suregard) was sprayed after planting; then manual weeding was done during summer. Trees were measured in November 2012, after one-season growth, according to a systematic sampling plan (24 plants per treatment): number of sprouts per plant, height and diameter at the base of all shoots, individual shoot fresh weight, and dry weight for all shoots gathered per treatment. Border trees were excluded from sampling for each plot or sector. All trees were pruned down after the first-year growth in November at 10 cm from the base, except for the Agrinova test in St-Bruno where the trees were not coppiced and kept full height. Hence, trees from the test were not sampled for fresh and dry weight, only data for height, diameter at the base, and the number of shoots per tree were recorded.

RESULTS

At the St-Bruno site, data vary according to clone and to microsite (Table 2). After one growing season, it is interesting to note large differences among clones for all variables. The number of sprouts per plant varied from 1,1 to 2,3, mean height and diameter of the largest sprout from 103 to 175 cm and 10 to 18 mm, respectively. The dendromass dry weight varied from 440 to 1475 kg/ha. For the replicated test with four clones, where no destructive sampling was performed, we could compare the diameter at the base of the largest sprout with the data from the same clones in the adjacent plantation (Table 3). On that basis, we could predict the biomass yield produced in the test. Growth did not differ for the two densities after the first growing season. For all clones, tree growth in block 2 was slightly inferior than the two other blocks. Dendromass data from test B at Saint-Paul (Fig. 2) are shown in Table 4, as a example of the first-season growth results obtained on a less fertile site than Saint-Bruno.

DISCUSSION AND CONCLUSION

As expected, poplar growth is largely reliable to site conditions but clonal characteristics varied sufficiently to select for traits suitable for SRIC crops. Survival at high density with repeated coppicing, as well as resprouting and sustainability of the stools over recurrent growth cycles are key factors to ensure high production over time. Large populations of superior hybrids are already available for evaluation and testing over different coppicing regimes.

Table 1. Clone frequency, block number, and plant density by location and plantation.

		OLO		Agrinova	
		Bas-Saint-Laurent		Lac-Saint-Jean	
		Cacouna	Cacouna & St-Paul	St-Bruno	
Clone	Hybrid	Test A	Test B	Test	Plantation
3478	NxM				
3729	NxM				
750301	MxT				
915308	MxB				
915311	MxB				
915318	MxB				
916401	DNxM				
102380	MxN				
102605	MxDB				
102890	MxN				
103177	MxN				
103712	MxN				
103854	MxN				
104090	MxN				
Blocks		3	4	3	---
		Cacouna	(2)		
		St-Paul	(2)		
Density		10 000	10 000	9 000	
plts/ha				15 000	15 000

Table 2. Mean Data per clone for two sectors of the poplar plantation in St-Bruno

Plantation	Sector A*					Sector B*				
Clone	Mean nb of sprouts /plt	Mean height of largest sprout/plt (cm)	Mean diameter largest sh (mm)	Mean dry weight/plt (g)	Dendromass dry weight (kg/ha)	Mean nb of sprouts /plt	Mean height of largest sprout/plt (cm)	Mean diameter largest sh (mm)	Mean dry weight/plt (g)	Dendromass dry weight (kg/ha)
3729	1,6	134,9	13,3	49,4	741					
102380	1,5	175,0	18,3	98,2	1475					
102890	1,9	141,1	14,1	56,3	845					
103177	2,3	134,1	14,4	77,5	1163					
103712	1,9	118,3	12,7	50,1	752					
103854	1,8	96,2	12,0	42,3	635					
104090	1,3	151,2	17,1	71,6	1076					
750301	1,3	147,3	14,7	65,7	987	1,5	114,4	10,5	29,3	440
915308	1,7	112,7	13,4	47,0	705	1,4	103,1	11,8	32,9	494
915318	1,5	119,7	13,2	48,5	729	1,1	130,0	14,1	52,8	792
915311						1,4	109,5	11,4	34,7	521

* Appr. 22 to 31 sample trees per clone per sector

Table 3. Mean diameter (mm) of the largest sprout at the St-Bruno test* in comparison with the contiguous plantation. Data expressed by clone, block and density**

Block (St-Bruno test)	B1		B2		B3				Mean Diam./cl.	Plantation	
Density**	D1	D2	D1	D2	D1	D2	D1	D2		Sector A	Sector B
750301	16,0	17,6	15,4	16,2	19,4	19,6	17,0	17,8	17,4	14,7	10,5
915311	17,1	17,3	15,9	15,5	16,6	13,7	16,5	15,5	16,0		11,4
915318	15,8	15,6	13,3	10,7	17,8	16,9	15,7	14,4	15,0	13,2	14,1
915308	16,6	16,5	15,6	11,5	12,7	16,9	15,0	15,0	15,0	13,4	11,8
Mean Diam./tr./bl.	16,4	16,7	15,0	13,5	16,6	16,8	16,0	15,7			

* Mean of 24 sample trees per plot
** D1: 9 000, D2: 15 000 plants/ha

Table 4. Mean dendromass per clone from the poplar test in St-Paul after one year

	Dendromass dry weight (kg/ha)		
Clone	Block 1	Block 2	Mean
3478	402	315	359
3729	264	444	354
750301	388	365	377
915308	269	339	304
915311	431	435	433
916401	234	295	265

Figure 1. Saint-Bruno poplar test (left) and adjacent-coppiced plantation (right) in spring 2013.

Figure 2. Cacouna poplar test A (left) and Saint-Paul poplar test B (right) in late October 2012.

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