CENTRE FOR BOREAL RESEARCH
TECHNICAL NOTE #40
FOREST RECLAMATION AND BOREAL REFORESTATION - SYNTHESIS OF TECHNIQUE – FEBRUARY 2021

Timing of Planting: What Are Our Options?

CONTEXT

In forest reclamation, the use of nursery stock seedlings is often desirable as this plant material provides greater assurance of woody plant cover development, whereas leave-for-natural-recovery approaches may require longer time periods for comparable recovery. The downside to actively planting seedlings is the much longer planning window required to produce nursery stock seedlings as seed must first be obtained, seedlings grown, and finally planted on the site.

This technical note illustrates the trade-offs in potentially shortening this planning window through the use of hot-planted seedlings, as well as unrooted hardwood cuttings in a riparian environment.

STUDY DESIGN

This study was conducted on a portion of a decommissioned airstrip located approximately 30 km northeast of Peace River, Alberta (lat 56° 23.792′ N, long 116 52.887´W). The riparian zone covers approximately 1.5 hectares and surrounds a reclaimed mineral wetland (Figure 1). Commonly occurring woody species in riparian zones adjacent to wetlands include river and green alder (*Alnus incana* and *A. viridis*), willows (*Salix* spp.), paper birch (*Betula papyrifera*), and balsam poplar (*Populus balsamifera*). These species were established as either dormant (no leaves, either rooted seedling or hardwood cutting) or hot (leaves present, physiologically active) in order to investigate a range of options for practitioners in revegetation of this type of feature (Table 1). Dormant or hot establishment types were planted into alternating strips (35 m wide x varying length) and vegetation surveys were conducted annually for four years.

Vegetation surveys were completed approximately every 7 m along the longest possible diagonal transect in each treatment strip. At each survey point, one 1.78 m circular plot (10 m^2) was used to measure stem density and maximum height by woody species. In the final year of study, measured trees and shrubs were aged in planting strips where fill-planting had occurred in order to separate in-fill seedlings from experimental seedlings. Seedling age was based on growth increment and evidence of bud scars of leading shoots.

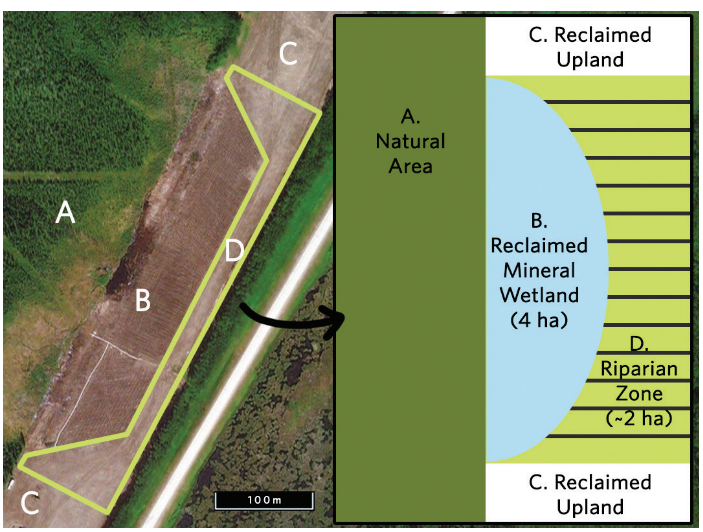

Figure 1 (left). Experimental layout within the larger airstrip study area. The inset shows the relative location of treatment strips (each 35 m width, length varying by intersection to maximum of 100 m within wetland study area). Individual strips varied from 0.11 – 0.43 ha in size.

PLANT SPECIES/ GROUP	DORMANT ROOTED SEEDLING	DORMANT UNROOTED CUTTING	HOT ROOTED SEEDLING
Alders	X		X
Paper birch	X		X
Balsam poplar		X	X
Willows		X	X

Table 1 (above). Type of plant material under evaluation. Dormant refers to plant material that was previously frozen prior to planting. Hot stock in all species represented container stock that had been grown in the 2-3 months prior to planting and were established in a non-dormant state.

KEY FINDINGS

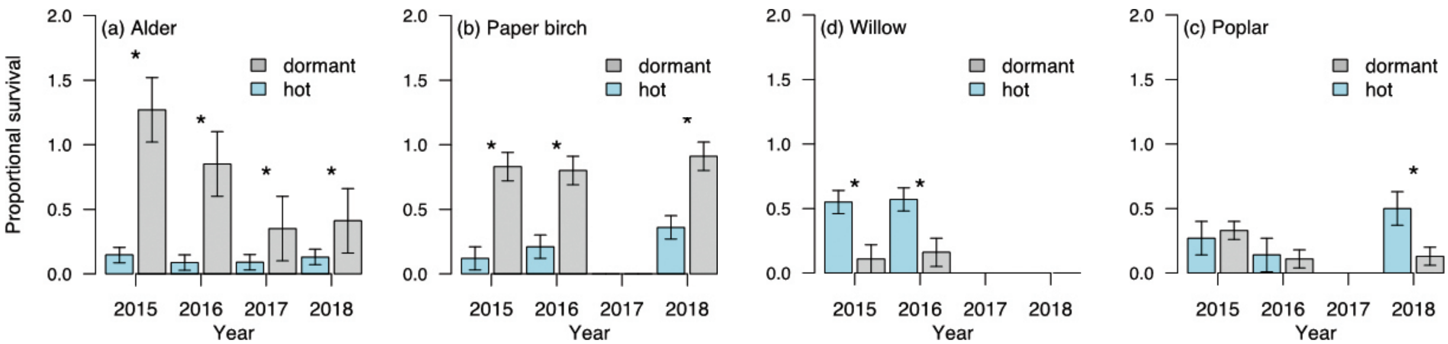

Figure 2 (above). Mean proportional survival estimated by observed density over original planted density during the four-year study period (2015-2018) for (a) alder (*Alnus incana* and *A.viridis*), (b) paper birch (*Betula papyrifera*), (c) poplar (*Populus balsamifera*) and (d) willow (Salix spp.). In some cases, due to the heterogeneity in planting, a mean value greater than 1 was possible. Missing values in 2017 (paper birch, poplar and willow) and 2018 (willow) occurred where infill planting made the separation of study plants from operational plants difficult to distinguish. Error bars represent one standard error of the mean (n=4-5 replicate blocks per treatment). * indicates a significant difference ($p < 0.05$) between treatment means within each year of measurement.

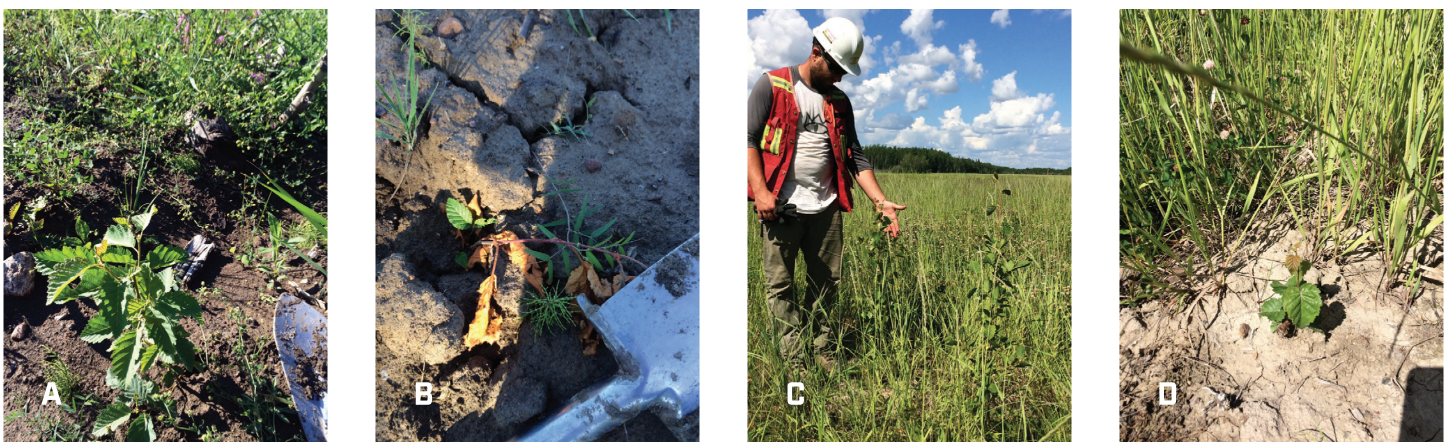

Figure 3 (above). Images from the first growing season illustrating alder established from (a) dormant or (b) hot stock and paper birch in the second growing season illustrating (c) dormant or (d) hot stock.

PRACTICAL RECOMMENDATIONS

RECOMMENDATIONS WHEN ESTABLISHING ALDER SPECIES OR PAPER BIRCH

Nursery production of dormant versus hot stock (if both are rooted in the greenhouse) share similarities in costs for obtaining seed, sowing and growing stock, and planting in the field, though some opportunity exists for cost savings with hot stock due to the lack of cold storage. Using hot stock can also reduce the lengthy planning timeline required as it can be grown and planted in the same season.

However, there was substantially greater mortality of hot-planting stock during the extreme conditions (spring drought and herbaceous competition) of this study (Figure 2-3). Greater mortality translates into greater long-term costs; in the current study the hot stock treatment strips had herbicide applied, and subsequent in-fill planting was required to bring woody densities back up after the high mortality experienced early on in the trial. Although more front-end planning and time is required for spring stock, this option is likely the most prudent course of action for the majority of cases, especially when facing a range of site-limiting constraints such as drought or competing vegetation.

RECOMMENDATIONS WHEN ESTABLISHING WILLOW SPECIES OR BALSAM POPLAR

Using unrooted hardwood cuttings is another approach that circumvents the planning requirements around nursery propagation. In this study, however, this approach was a failure and the extreme combination of herbaceous competition coupled with dry conditions are primarily to blame. In situations of adequate moisture and lower competing vegetation, survivorship of approximately 50% is reasonably achievable. Nevertheless, when comparing the relative survival experienced by the unrooted cuttings against hot-planted rooted seedlings in this particular set of circumstances, it was clear that roots were highly advantageous for the establishment of balsam poplar and willow in a dry, competitive environment. This suggests that where there is uncertainty as to seasonal moisture, investing in the production of rooted seedlings (even if hot-planted) will be more cost-effective simply due to improved rates of survivorship, as the cost to produce a rooted seedling (approximately $0.75/plant) will be comparable to the effort to collect unrooted cuttings. This is assuming at least 40 cm willow cutting length with 1-2 cm of diameter ($0.5- $1.0 per cutting, with a labor cost of $500 per day and productivity of 500-1,000 cuttings collected per day).

COST IMPLICATIONS

Key points on costs:

1. Poor survival outcomes are strongly tied to higher establishment costs.
2. Inherent differences in survival are also important in terms of driving per hectare cost differences.
3. In general, dormant rooted seedlings were the most cost-effective way to establish woody vegetation followed by hot-planted rooted seedlings.

SPECIES/ GROUP	PLANT MATERIAL	DORMANT/ HOT	COST TO GROW OR COLLECT ($/PLANT)		COST TO PLANT ($/PLANT)	SURVIVAL	# PLANTS REQUIRED TO ACHIEVE 1,000 (STEMS HA^{-1})	COST TO IMPLEMENT (PER HA)	
			LOWER	UPPER				LOWER	UPPER
Alders	Rooted seedling	Dormant	$0.50	$1.00	$0.75	0.99	1010	$1,262.63	$1,767.68
		Hot	$0.40	$0.90	$0.75	0.15	6667	$7,666.67	$11,000.00
Paper birch	Rooted seedling	Dormant	$0.50	$1.00	$0.75	0.92	1087	$1,358.70	$1,902.17
		Hot	$0.40	$0.90	$0.75	0.37	2710	$3,116.53	$4,471.54
Balsam poplar	Rooted seedling	Hot	$0.40	$0.90	$0.75	0.50	2000	$2,300.00	$3,300.00
	Unrooted cutting	Dormant	$0.50	$1.00	$0.75	0.14	7143	$8,928.57	$12,500.00
Willows	Rooted seedling	Hot	$0.40	$0.90	$0.75	0.58	1730	$1,989.62	$2,854.67
	Unrooted cutting	Dormant	$0.50	$1.00	$0.75	0.17	5882	$7,352.94	$10,294.12

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