RES-FOR HIGHLIGHT #1

Jan 2019

The impact of policy on the benefits of adopting genomic technology in the Alberta forest sector

Overview

The competitiveness of the Alberta forest sector is facing threats from multiple directions including supply constraints due to the Mountain Pine Beetle devastation and unusually high fire losses. The adoption of genomic technology and the use of improved seeds are expected to improve timber productivity in Alberta. Traditional tree breeding of boreal conifer species takes about 30 years to complete one breeding cycle, making it difficult to respond quickly to external changes (e.g., climate change, new regulations and changes in the market). With the adoption of genomic technology, the tree breeding cycle can be significantly shortened: by up to 20 years in some cases. Moreover, genomic selection delivers more accurate breeding values and allows for a higher intensity of selection than traditional breeding methods. However, the use of genomic technology will need to take place within the confines of the public-private nature of the sector where 93% of the total forest area is publicly owned. In particular, the role of the “allowable cut effect" (ACE) has significant impacts on the incentive to invest in new productivity-enhancing technologies.

Goals & Objectives

What are the economic benefits of adopting genomic technology in the Alberta forest sector under different policy scenarios?

Outcomes & Deliverables

The results of this study will be useful in guiding public investment decisions on genomic research and policy decisions on the use of the ACE in Alberta. The contributions of this paper go beyond its role as a case study of adopting genomic technology in Alberta. Forest genomics research is being undertaken all over the world, especially in Canada, U.S., and Sweden where forestry is a key sector. Lessons learned from this study could provide guidance to other regions interested in adopting genomic technology on how best to formulate policy to encourage the adoption of productivity-enhancing technologies.

Methods & Scenarios

Two-step approach:

1. Quantify the increase in harvest volume attributable to the use of improved seed through a timber supply simulation model.
2. Integrate the timber supply change information into a global forest product trade model which is used to measure the economic surplus gain.

Scenarios:

Breeding Strategies	Genetic Volume Gain (%)	R&D Lags (years)	R&D Costs (M C$)
2nd Gen. Improved Seeds			
TB	15	18	6.5
GATB	20	18	16.4
3rd Gen. Improved Seeds			
TB	25	38	7.9
GATB	30	23	16.3

Table 1: Elicited parameters for different R&D (research & development) scenarios. Note: TB = traditional breeding; GATB = genomics-assisted tree breeding; Gen. = generation.

Conclusions

1. It is beneficial to use the ACE policy instrument to encourage investment in tree improvement in Alberta because the simulated ACEs in all breeding scenarios are positive (Table 2).

Scenarios	AAC(M m^3)	ACE(M m^3)	Timber supply change (%)	SWL supply change (%)
Baseline	18.5	0	0.0	0.0
BAU	19.2	0.7	3.8	3.8
2nd Gen. Improved Seeds				
TB	20.7	2.2	11.9	11.9
GATB	21.3	2.8	15.1	15.1
3rd Gen. Improved Seeds				
TB	22.6	4.1	22.2	22.2
GATB	23.3	4.8	25.9	25.9

Table 2: Simulated allowable cut effects (ACEs). Note: Gen.= generation; TB = traditional breeding; GATB = genomics-assisted tree breeding.
Note: The R&D lag for the 2nd Gen. is 18 yrs for TB & GATB, and 38 yrs for TB & 23 yrs for GATB in the 3rd Gen.

2. Using 3rd generation improved seeds produced through genomics-assisted tree breeding can generate significantly more economic benefits, indicating that the main driving factor of the economic returns is the time saved during the breeding process (Figure 1).

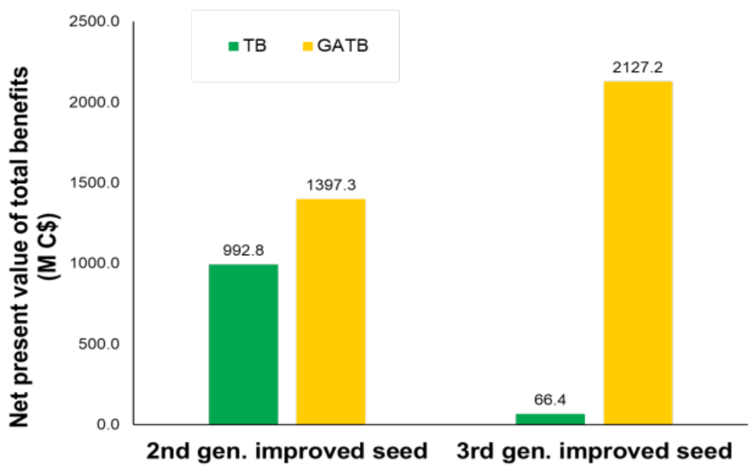

Figure 1: Discounted total benefits of adopting improved seed produced using TB and GATB, 2016-2053, r=4%.

3. The size and opportunity to realize the economic benefit of adopting genomic technology is controlled by government policy (i.e., allowable deployment area). In certain scenarios, the economic benefits associated with GATB are not able to offset the R&D costs (Table 3).

Adoption rate (%)	Genetic Volume Gain at Rotation (%)					
	6	10	15	20	25	30
100	126	325	724	1031	1741	2127
80	28	171	518	677	1197	1516
60	-16	28	325	416	724	983
40	-113	-69	126	225	325	472

Table 3: Discounted economic returns (Millions of C$), under various genetic volume gains and adoption rates (i.e., allowable deployment area) with the 3rd gen. GATB improved seeds (2016-2053, r=4%).

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