Report: Status of Tree Improvement in Alberta – 2021

July 14, 2022

Foreword

The purpose of this report is to briefly update the status of tree improvement in Alberta, including seed production, deployment of material and representation of parents in progeny trials and production facilities. Previously, this information was reported by the Alberta Forest Genetic Resources Council (AFGRC), which has unfortunately been inactive for many years. TIA feels this information is important to report on so that those interested in tree improvement may have an overview of program development and to showcase the success of these programs.

TIA 10 Year Anniversary

In 2022, Tree Improvement Alberta will celebrate its 10th anniversary. The Board would like to thank all of its collaborators, including the industrial partners who provide funding for TIA's activities, the Government of Alberta and the University of Alberta for helping the organization to support tree improvement in Alberta. The Board looks forward to continuing to serve as a tool to drive the continued development of tree improvement, as well as supporting research and dissemination of information important to the industry. Follow this link for the AFGRC report noting the formation of TIA: GeneticAR2011.pdf (abtreegene.com)

Status of Coniferous Tree Improvement Programs

In Alberta, there are 22 coniferous tree improvement programs with 12 programs supported by Alberta Agriculture, Forestry and Rural Economic Development (AFRED) and 10 programs supported by the following industry partners: ANC Timber Ltd., Canadian Forest Products Ltd. (Grande Prairie and Whitecourt Divisions), Tolko Industries Ltd, High Level, West Fraser Mills Ltd. (Manning Forest Products, Hinton Wood Products and Blue Ridge Lumber) and Weyerhaeuser Company Ltd. (Grande Prairie and Pembina Timberlands).

Of these 22 programs, 20 are focused on producing material for reforestation, including all industry programs. The two remaining programs, Regions F1 and M, were established for the conservation of Douglas-fir and western larch, respectively, and managed by Alberta Agriculture, Forest and Rural Economic Development (AFRED).

A total of 25 seed orchards are operated under these 22 conifer CPPs. Twenty-two of the orchards are first generation (Phase 1) orchards comprised primarily of wild-selected clones (grafts and seedlings), with some forward and backward selections included in several orchards. Three orchards are second generation (Phase 2) orchards composed of a mix of forward and backward selections. Levels of genetic gain for these orchards range from 0% (e.g. Sb programs for secure seed supply) to ~11% for height (G810 – B2 Phase 2 Pl) at a rotation age of 80 years.

Overall, AFRED and industry orchards have produced almost equal quantities of seed (by weight) – approximately 4,760 kg total. AFRED has produced 64% of Alberta's white spruce seed (3,452.2 kg total production), while industry has produced 93% and 87% of Alberta's Lodgepole pine (1,141.7 kg total production) and black spruce (99.4 kg total production), respectively. Sixty-one percent of land reforested using orchard seed was sourced from industry orchards, with the remaining 39% being produced in AFRED orchards. Deployment of improved seed is steadily increasing year-over-year.

The following table and graphs summarize specific program information and total hectares cumulatively planted to 2021, and seed produced to 2020.

Table 1: Summary of Alberta's coniferous tree improvement programs to end of 2021.

Species	Number of Programs	Parents in Programs	Parents under test	Genotypes in orchards	Trees in orchards	Total seed produced (kg)[1]	Area planted (ha)
Douglas-fir	1	45	-	37	92	1.7	-
Western larch	1	42	-	42	156	2.8	-
Jack pine	1	87	87	58	540	61.1	74
Lodgepole pine	7	2,843	2,555	791	11,599	1,142	81,417
Black spruce	3	367	269	220	3,589	99.4	5,799
White spruce	9	1,830	1,484	730	7,554	3,452	149,203
Total:	22	5,214	4,510	1,878	23,530	4,759	236,493

1 – Total seed produced is given for all crops collected up to 2020.

Figure 1: Hectares planted annually with improved seed in Alberta up to 2021. Note that '2005' includes all area planted up to and including 2005.

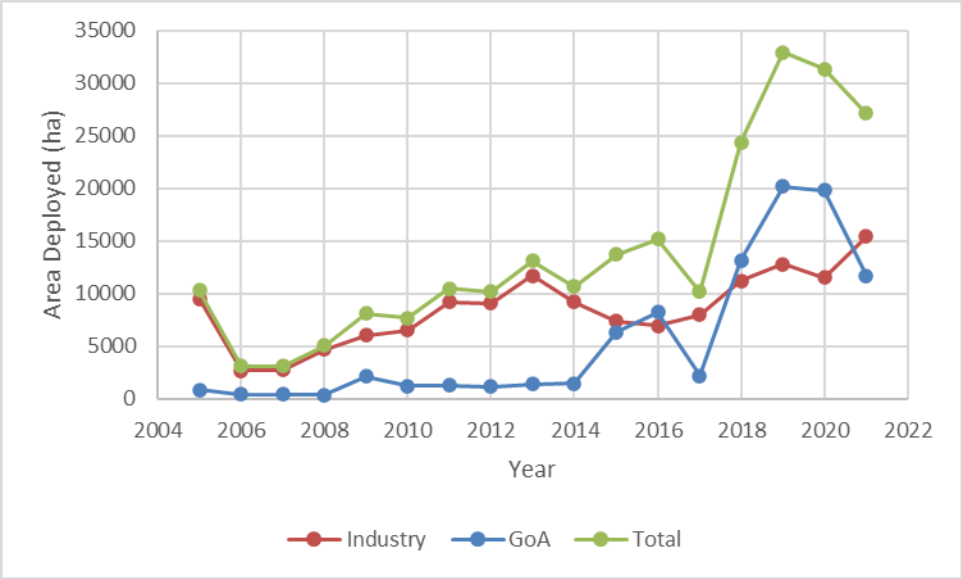


Figure 2: Improved seed produced annually in Alberta up to 2021. Note that '2008' includes all seed produced up to and including 2008.

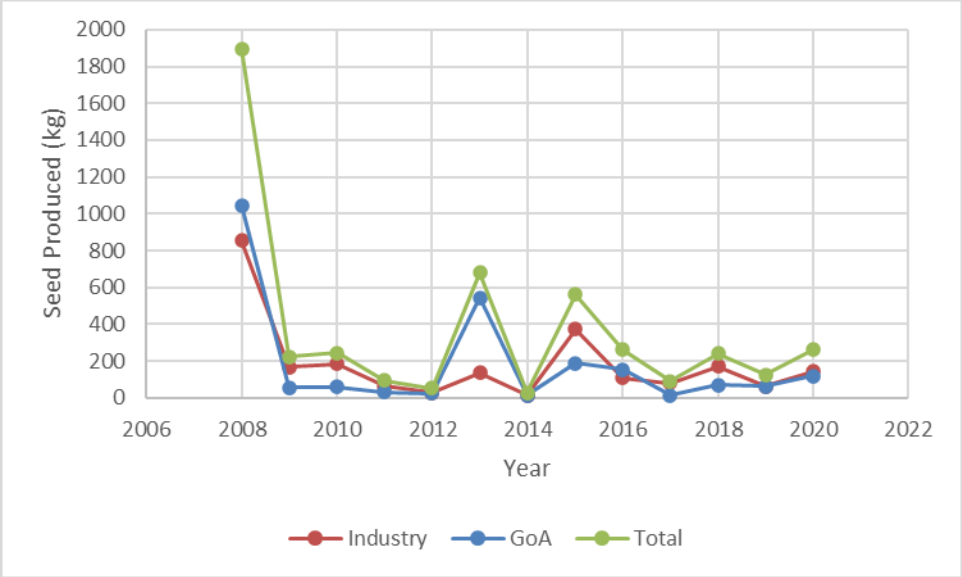


Figure 3: Total hectares planted with improved seed (Pl, Sw and Sb) in Alberta up to 2021. (Pl callout is GoA deployment; Sb callout is Industry deployment)

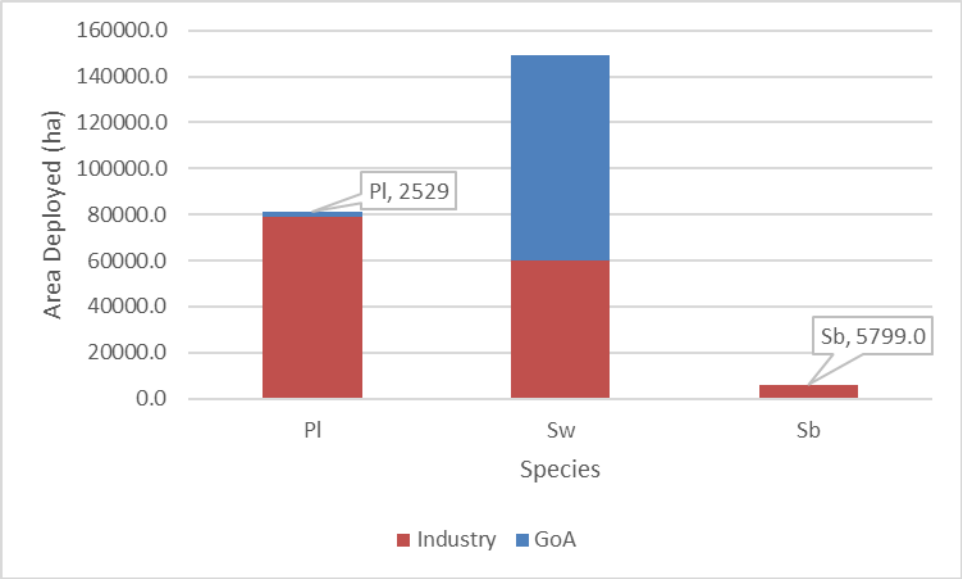
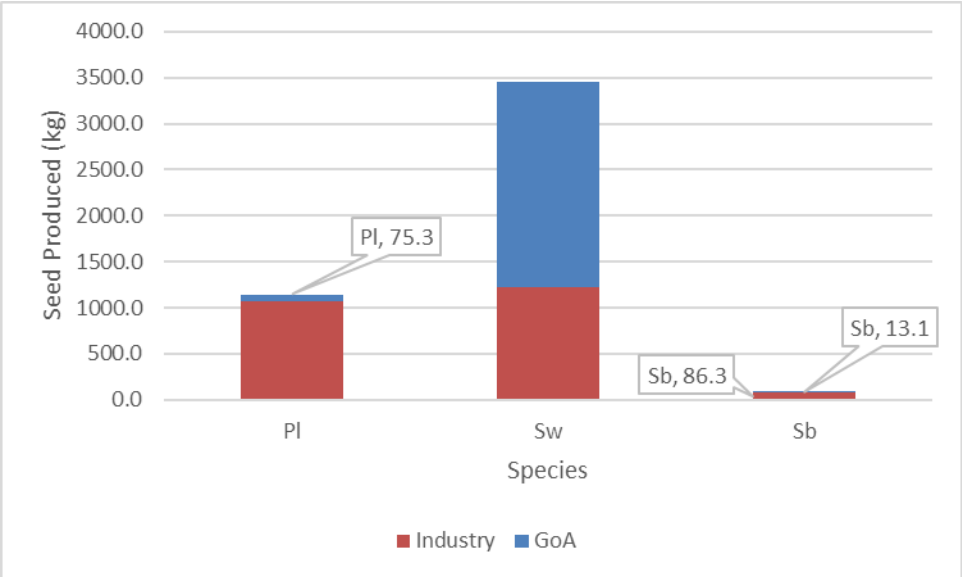


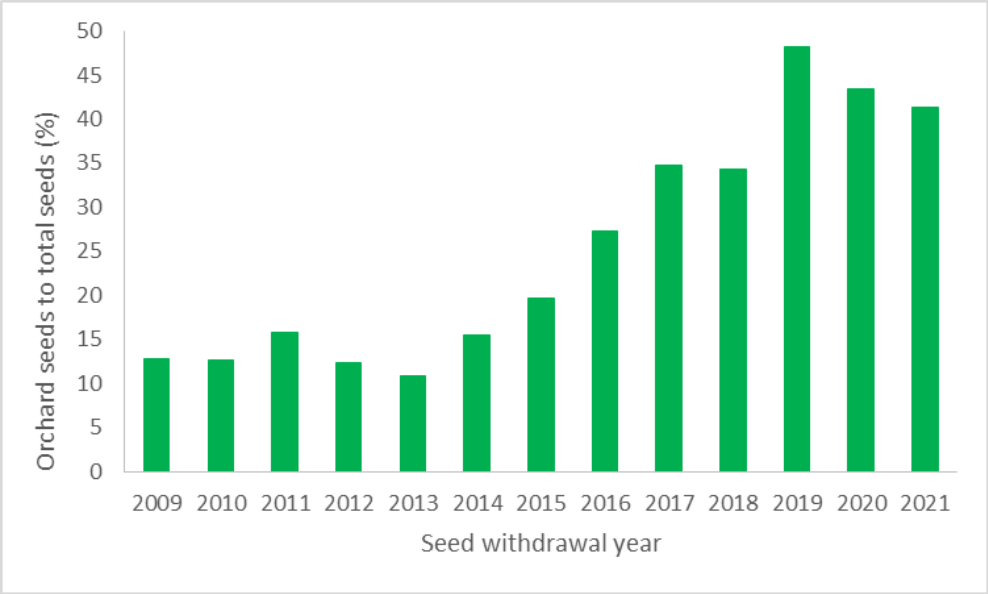
Figure 4: Total improved seed (Pl, Sw and Sb) produced in Alberta up to 2020. (Pl callout is GoA seed production; Sb callouts are for both Industry (86.3) and GoA (13.1) seed production)



Provincial Summary

The Alberta Tree Improvement Seed Centre (ATISC) tracks seed orchard seed use within the province. The following graph shows deployment of orchard derived conifer seeds expressed as a proportion of the total deployed seeds from 2009 to 2021. Since 2017, orchard seed deployment has been >30% of total deployment and in 2019 48.2% of total deployed seed came from an orchard. (Source: Andy Benowicz, Forest Genetics Specialist, ATISC).

Figure 5. Deployment of orchard-derived conifer seeds in Alberta expressed as a proportion to the total (wild and orchard) deployed seeds. The proportions were adjusted by species-specific number of seeds/kg and sowing rates.



Status of Deciduous Tree Improvement Programs

There are three deciduous tree improvement programs in Alberta – AW1, AW2 and Pb1. The AW1 program is operated by Mercer Peace River Pulp Ltd, while AW2 is operated by Weyerhaeuser (Grande Prairie Timberlands) and West Fraser – Grande Prairie, A Division of West Fraser Mills Ltd. Both programs are managed through the Western Boreal Aspen Corporation (WBAC). The PB1 CPP was operated by Alberta-Pacific Forest Industries Ltd., but is presently dormant.

Both the AW1 and AW2 CPPs are operated to deploy material improved for wood volume production. Currently, both programs maintain 30 genotypes each for clonal deployment, which is anticipated for 2022, 2023 and 2024. Ten progeny trials have been established, with climate change considerations, and are testing the performance of full-sibs, half-sibs and clones and will be used for selecting new clones for deployment.

Summary of Responses to Tree Improvement Questionnaire

In 2021, TIA sent out a questionnaire to stakeholders regarding the status of their tree improvement programs. A summary of these questionnaires, and a sample questionnaire, may be found below.

- Responses were received from industry or AFRED representatives for the following programs:
    - A1 Pl – West Fraser (Hinton)
    - A2 Pl – West Fraser (Hinton), Weyerhaeuser (Pembina)
    - AW1 – Aw – Mercer
    - AW2 – Weyerhaeuser (Grande Prairie), West Fraser (Grande Prairie)
    - B1 Pl – Canfor (Grande Prairie), Weyerhaeuser (Grande Prairie), ANC Timber
    - B2 Pl – West Fraser (Hinton), Weyerhaeuser (Grande Prairie)
    - C – Pl – West Fraser (Blue Ridge)
    - D – Sw – West Fraser (Blue Ridge)
    - G1 – Sw – Canfor (Grande Prairie), Weyerhaeuser (Grande Prairie)
    - G2 – Sw – West Fraser (Manning), Tolko (High Level), ATISC
    - I – Sw – ANC Timber, Canfor (Whitecourt), Weyerhaeuser (Pembina), West Fraser (Hinton)
    - L1 – Sb – ANC Timber, Canfor (Whitecourt), West Fraser (Hinton)
    - L2 – Sw – Canfor (Grande Prairie), Weyerhaeuser (Grande Prairie)
    - J – Pl – West Fraser (Manning), Tolko (High Level), ATISC

Summary organized by questionnaire topics:

Purpose

- All Pl, Sw and Aw programs are operated primarily for enhanced growth, while Sb programs are operated for a secure seed supply.

Orchard generation

- All Pl programs have Phase 1 orchards, while there are three Phase 2 orchards – G804 (B1), G810 (B2) and G827 (C). Hinton Wood Products is in the planning stages for a Phase 2 orchard for the A1 program.
    - The Sw orchards for G1 and I are maintained as rolling front orchards, while the G2 and D orchards are Phase 1 orchards.
    - All Sb orchards for the L1 and L2 programs are Phase 1 orchards.
    - There are no orchards for AW1 or AW2 – a clonal propagation method is utilized for selected clones.

Priorities

- Some Pl and Sw programs consider at least one secondary selection trait. Secondary traits include DBH and western gall rust (WGR) resistance. Evaluation of other traits will be considered in most programs as required to meet objectives.

- Climate change was identified as a present concern for all programs, except for L1 and L2.

Expansion

- There are no planned expansions of current orchards, except for G810 (B2 Phase 2).
    - A second orchard for G2 is being evaluated (with no firm plans), while a Phase 2 orchard is in the early planning stages for A1.
    - A second orchard may be evaluated for Region D, or the existing orchard may be converted to a rolling front.

Genomics

- Only one proponent – West Fraser (Hinton) – will be using genomics to advance program objectives. Genomics will be used to reconstruct the pedigree of unknown families at two test sites under the Region A1 program in 2022-2024 in partnership with the Thomas Lab at the University of Alberta.
    - Other Pl and Sw programs (except G2 and J) may evaluate future use of genomics for increasing gain estimates, pedigree reconstruction and genomic selection.

Status of Tree Improvement Questionnaire

Please provide the following information for each Controlled Parentage Program (CPP) your company/organization is supporting. If the CPP is jointly run, please complete only one survey. This information will be used by Tree Improvement Alberta to complete the biennial report, Status of Forest Genetics Programs in Alberta. Thank you! Please return completed form to jbeal@forsite.ca by July 19, 2021:

Breeding Region:	
Species:	
Orchards:	
Progeny Trials:	
Year Program Began:	
CPP proponents:	

Questions	**Response**
What is the purpose of the program?	
Orchard generation: What generation is the orchard at or is the orchard managed as a rolling front? Expected life of orchard? Is this a year? How many genotypes are in your orchard? *Clonal program*: How many clones are being maintained in your stoolbeds or other clonal propagation system?	
Priorities: Are priorities in your CPP shifting from height as the only selection trait to including others such as diameter, drought resistance, wood density, western gull rust (WGR), spruce budworm (SBW), etc? If yes, please specify. Is climate change a consideration? (Yes/No)	
Sb orchards: Is the focus changing from just seed supply to gain? (Yes/No)	

Expansion: Is there a planned expansion, controlled cross breeding or a second generation orchard in development? If yes, please state when and if no, please explain why not?	
Genomics: Is the use of genomics being introduced into the program (e.g., to increase genetic gain, pedigree reconstruction, pollen contamination, genomic selection etc.) If Yes, please specify reason)?	