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Opportunities and Obstacles for Private Plant Breeding in Canada

Jodi Souter

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SCHOLAR PROFILE

Jodi Souter grew up on a mixed grain and beef farm in northeastern Saskatchewan. Jodi always had an interest in the grain part of the business and, starting in her undergraduate studies, pursued her passion in plant breeding. She earned a PhD from the University of Saskatchewan and became a CSGA-recognized plant breeder. Jodi is also an adjunct professor at the Irving K. Barber School of Science at the University of British Columbia and was recently recognized as one of 2023's Next Generation Leaders by Germination Magazine.

Following her entrepreneurial roots, which she developed on her family's farm, Jodi co-founded an independent plant breeding company, J4 Agri-Science Limited, in December 2019. Recognizing that starting a private plant breeding company is rare in Canada but not in the rest of the world, Jodi wanted to dive into startup, independent, and small plant breeding companies that exist internationally to understand the challenges they face and the successes they have achieved. Jodi wanted to compare international approaches to plant breeding with the landscape that exists in Canada to explore why small, independent, and start-up plant breeding companies struggle to exist in Canada.

FOREWORD

For any industry to continue to innovate and compete globally, ongoing reflection needs to be done to understand what parts of the system are working well, what parts of the system can be improved, and what parts of the system need a complete overhaul.

Crop variety development in Canada is no exception.

In Canada, we aren't keeping pace with the rest of the world when it comes to building a platform for independent plant breeding to be competitive and successful. This is a detriment to the industry. When plant breeding is successful, every other part of the supply chain benefits, and it is evident from other countries' experiences that independent plant breeding does contribute to success. Discussions have occurred over the past several years on how to improve the industry in Canada, including discussions on how to spur innovation through independent plant breeding, but few changes have resulted. Because plant breeding is a lengthy process taking 10-15 years for the release of a new cultivar in Canada (Baker and Pozniak, 2013) and successes resulting from changes to the norm are not instantly evident, regulatory and perception changes are immediately required to improve the future of the plant development landscape. Without action, opportunities for innovation and growth will continue to be lost.

Of particular interest to me is why Canada's entrepreneurial-minded plant breeders are not being utilized to their full potential. Few small start-ups, small to medium-sized enterprises (SME), and independent plant breeding companies exist in Canada, especially in Western Canada. In contrast, these types of companies are providing competition in the plant breeding space, and creating alternative varieties for local farmers, almost everywhere else I travelled. Indeed, private plant breeding is so common in some areas, particularly in Western Europe, that these regions could not figure out why I was even asking this question.

Did you know that there are crops in Canada with less than one breeding program dedicated to their development? And several other crops only have one or two programs. A singular approach to innovation, particularly where complex issues exist, can not generate the efficient and nuanced responses of a multi-faceted approach. Furthermore, only a limited

number of objectives can be worked on by a single breeding program, resulting in objectives that may be vital for some farmers' successes left unachieved. If certain of the obstacles that currently exist in Canada are removed, small and local start-up private companies could easily fill in the gaps that exist in the variety development space.

By increasing the number of independent plant breeding programs in Canada, we will see more crops developed to their full potential, increased investment in development that offers alternative uses of crops, more diversity of seed choice, and the ability of farmers to hedge their bets and support initiatives that are being productive in developing varieties for their needs. This report seeks to identify the gaps in the crop breeding industry in Canada and offers strategies and recommendations to strengthen the sector and stimulate the independent plant breeding lane of crop development.

I am attempting to build a private plant breeding company. We have no guarantee of success. Instead, the risk of failure when starting a plant breeding company in Canada is very high. Through this Nuffield study, I hope to positively impact independent plant breeding in Canada so it is possible for companies like mine, J4 Agri-Science Limited, to exist; Canadian agriculture will win when they do.

ACKNOWLEDGMENTS

A big thank you to John Cote and Barb Stefanyshyn-Cote, Nuffield recruiter extraordinaires, who suggested the Nuffield Scholarship to assist me in the development of my breeding program despite the obstacles to independent plant breeding in Canada.

Thank you to the NAT'22 (Nuffield Zimbabwe Tour) crew for being the highlight of my entire Nuffield experience. The lessons learned and the friendships made during this tour are second to none. I feel so grateful to have been able to experience this once-in-a-lifetime opportunity.

Thank you to my fellow Nuffield 2020 scholars. Undertaking a travel scholarship during a pandemic was tricky (to say the least), and I greatly appreciated being able to lean on other scholars for support during this adventure.

Thank you to everyone who suggested someone to visit, everyone who made contacts for me, everyone who had calls with me, and everyone who hosted me (again, during a pandemic). I learned so much during this study because of all of you.

But most importantly, thank you to my ever-supportive family, who should probably start dissuading me from all of the crazy ideas I get, but never do. Instead, they are always right there to back me up and lend a hand when needed. My life lottery win is, and always will be, my family.

Image 1: Welcoming the 2020 scholars at the Nuffield AGM in Fredericton (November 2019).

SPONSORSHIP

My Nuffield Scholarship was sponsored by the Canadian Canola Growers Association. Additional sponsorship was provided by Saskatchewan Pulse Growers, CropLife Canada, and the Canadian Seed Trade Association.

EXECUTIVE SUMMARY

Competition within the plant breeding and crop development sector is important to motivate the efficient production of more and better crop varieties for farmers. One way to increase competition in the Canadian system, where many crops have few breeding programs, is to support the existence of private plant breeding companies.

Plant breeding start-ups and small and medium-sized enterprises (SMEs) are abundant and successful in other countries. So, why not in Canada? Why is Canada primarily reliant on the public sector for crop variety development? To find out, I embarked on a Nuffield scholarship to explore the opportunities and obstacles for private plant breeding in Canada by comparing the industry in Canada to that in other countries.

There is no proven formula for starting or funding a new private plant breeding company, with most companies responding to the needs in their environment and being innovative within the system in which they exist. Internationally, of the businesses I consulted, some companies started as purely private and developed their own germplasm pipeline, some companies formed when public breeding programs split and the public resources were made available to private companies, and other private companies started with public resources. In terms of funding, some companies were founded by groups of farmers, by distributors, or through outside investment, and others by, or with the assistance of, public, private, or commission funding. However funded, program funding, as opposed to project funding, was viewed as more successful in ensuring sustainable innovation.

A means of returning investment to those who take the risk of starting private breeding companies is necessary – a sentiment echoed across the globe. A return on investment is also needed for the continued success of the pipeline and to spur the innovation needed to keep crop varieties developed in Canada competitive with those available in other countries. At the moment, Canada does not have a fully industry-accepted way to return investment in inbred crops to breeding programs. This said, there has been a recent effort to develop a royalty collection system, the Variety Use Agreement (VUA) (Seeds Canada, 2024). To increase acreage in minor crops, to develop innovative and cutting-edge varieties, and to increase competition in

breeding, this Nuffield study concludes that the industry should support a royalty capture process.

Further, in many regions where private plant breeding companies are flourishing, breeding service provider companies have also been able to start and thrive. As particularly seen in Australia and Argentina during my study, companies exist solely to provide services to private plant breeding companies, including agronomy companies, genomic companies, chemical testing companies, disease testing companies, bioinformatic companies, and commercialization and regulatory companies. The trickle-down benefits of supporting private plant breeding will stimulate additional entrepreneurship in our seed industry.

Obstacles to developing private plant breeding companies need to be removed for the success and global competitiveness of the Canadian seed sector. This report explores several themes that became apparent during the course of this scholarship that underlie the barriers to the entry and success of independent plant breeding in Canada.

DISCLAIMER

This report has been prepared in good faith but is not intended to be a scientific study or an academic paper. It is a collection of my current thoughts and findings on discussions, research and visits undertaken during my Nuffield Farming Scholarship.

It illustrates my thought process and my quest for improvements to my knowledge base. It is not a manual with step-by-step instructions to implement procedures.

Neither The Nuffield Farming Scholarships Trust, nor my sponsor, nor any other sponsoring body guarantees or warrants the accuracy, reliability, completeness or currency of the information in this publication or its usefulness in achieving any purpose.

Readers are responsible for assessing the relevance and accuracy of the content of this publication.

Scholar Contact Details
Jodi Souter
Saskatoon, SK
jodi.r.souter@gmail.com
In submitting this report, the Scholar has agreed to Nuffield Canada publishing this material in its edited form.

NUFFIELD CANADA Contact Details
exec.director@nuffield.ca
nuffield.ca

TABLE OF CONTENTS

Contents

1.0 INTRODUCTION

The theme of this Nuffield study is "Opportunities and Obstacles for Private Plant Breeding in Canada." Canada, a global agricultural powerhouse, is not utilizing one key lane for plant breeding efforts: Canadian-developed small and medium-sized enterprises (SMEs). As a result, Canada is missing out on additional innovation in our seed sector.

During this study I travelled to areas where private plant breeding is thriving (Australia, Argentina, and the United Kingdom), to a place where several forms of plant breeding programs exist successfully in the same space (USA), to places where novel systems are creating opportunities for local agriculture (Uruguay and New Zealand), to the home of international organizations leading the charge in support of plant breeding (Switzerland), and to a place where people are actively developing opportunities in the face of major agricultural hurdles (Zimbabwe). Most importantly for this report, I have examined the obstacles in the environment which I passionately want to improve so that people with dreams like mine will thrive - my home, Canada.

The theme of the Nuffield study is quite broad: exploring the obstacles to private plant breeding in Canada. Several sub-themes emerged, including:

1) biotechnology regulations, and

2) intellectual property structure/farm-saved seed royalty capture.

After my early travels and discussions, it became apparent that I would also need to address:

3) registration regulations, and

4) industry perception.

Timing, speed, cost, and public opinion were determined to be factors that, along with the key regulatory issues, could make or break a private or independent company or completely block the private plant breeding lane altogether.

2.0 PRIVATE PLANT BREEDING IN CANADA

2.1 Biotechnology and Genomic Technique Regulation

2.1.1 Developing policy to allow Canada's breeders to compete globally

Plant biotechnology is regulated in Canada by the Canadian Food Inspection Agency (CFIA) under the *Seeds Act* (Government of Canada, 2016). Of specific interest to plant breeders is Part V of the *Seeds Regulations*, which sets out the regulatory requirements for the release of plants that may impact the Canadian environment. This policy includes Plants with Novel Traits (PNT)[1].

Canada has a trait-based system, meaning the regulation targets the trait expressed, not the method used to introduce the trait (Government of Canada, 2022). This is different from the process-based regulatory system, or other regulatory mechanisms, used in the rest of the world (Hubert, J., 2020). When introduced, Canada's science-based regulatory system had strong support and the hope was that it would result in Canada being more competitive on a global scale as it seemed like it was going to be more straightforward; however, the implementation of the PNT regulation was burdensome and acted as a barrier to innovation in Canada (Smythe et al, 2020). The issue arose in the practical application of the Canadian system -- there are countless traits that can be targeted in plants, and it is impossible to make a list of all traits for breeders to understand what is and is not included as a PNT. As Smythe concluded in his 2020 study surveying Canadian plant breeders:

> "*Ultimately, what public breeders are doing is undertaking breeding programs that have as little novelty as is possible, thus ensuring they are not regulated as PNTs. This raises the questions of what adoption rates these minimally novel varieties might have once approved and commercialized. Will producers*

[1] In the *Seed Regulations* Part V 107(1), a novel trait is defined as:

> a characteristic of a seed that (a) has been intentionally selected, created or introduced into a distinct, stable populations of cultivated seed of the same species through a specific genetic change, and (b) based on valid scientific rationale, is not substantially equivalent, in terms of its specific use and safety both for the environment and for human health, to any characteristic of a distinct, stable population of cultivated seed of the same species in Canada, having regard to weediness potential, gene flow, plant pest potential, impact on non-target organisms and impact on biodiversity. (Seed Regulations, 2024).

be willing to adopt new varieties that are only marginally better than existing ones?" (Smythe et al, 2020).

At the beginning of my Nuffield study, Canada launched a public consultation to update the determination of whether a plant is subject to Part V. This was a welcomed movement as it was clear, both in Canada and while travelling the world, that updates and clarifications were necessary. Public consultation closed on September 16, 2021. The policy was updated in May 2023 prior to the publication of this report and, as such, is reflected throughout this discussion.

Confusion was rampant among Canadian plant breeders prior to the 2023 updates to Part V of the *Seeds Regulations*, with breeders not feeling confident in their understanding of which traits would or would not be included as a PNT. Through consultation with Canadian breeders, it was determined that the confusion arose from previous regulatory overreach, unclear expectations, difficulty getting concise answers, the spread of misinformation amongst breeders, and a lack of clarity on the rules. That said, in discussions with Canadian regulators, the confusion seemed unwarranted. Somewhere between the people who drafted the regulations and the people applying or using the policy, misunderstandings were occurring.

Now that the policy has been updated, information sessions could be conducted to ensure that up-and-coming breeders understand the policy. Even more importantly, especially as breeder mentors are a major source of information for new breeders, these information sessions would re-educate current breeders on what the policy entails. Having "breeder-only" days with regulators would pay dividends for the future of the seed breeding industry: it would create certainty as to what was intended by the policy, permit breeders to voice concerns they may still have in relation to the application of the rules, and give breeders confidence in selecting their objectives and the traits they are attempting to target.

The new policy is a move in the right direction for plant breeding in Canada. That said, the regulations overseeing agricultural innovation, including variety development, should be reviewed and updated on a regular basis (at least every 5-10 years, not the 26 years it took to update Part V of the *Seeds Act*). This industry relies on innovation. Technological advancements happen quickly. No one should think that it is a good thing for plant breeders to be fearful of

improvements or feel like their hands are tied when it comes to innovation. In a globally competitive industry, Canadian breeders need to be allowed to compete on the same level and with the same tools as others around the world. Transparency and regulations should exist, but they should not be restrictive to the point of stifling Canadian innovation and, therefore, Canadian competitiveness. Over 10 years ago, this issue was raised as a problem when plant breeding company Cibus' mutagenesis-bred canola was released in the United States but was caught in regulatory hurdles in Canada, which were expected to last years:

> *"[…] even as the PNT system was being developed, some Canadian breeders argued that its "one size fits all" nature would impose costly regulation on some breeding in Canada that would not be imposed in other countries, creating an innovation barrier.*
>
> *Governments need to assess their regulations to ensure they keep up with scientific advancements in a way that still protect people and the environment but do not needlessly limit innovation or impede competition (Western Producer, 2014)"*

2.1.2 Trickle down effects from innovative policy

It was clear in travelling the world that competitive countries that allow for innovative techniques, such as gene editing or other new genomic techniques (NGT)[2], to be used, and novel traits to be developed, are rapidly making gains. This was most evident to me in Australia, likely due to me being a farmer who competes in the same export markets as Australian farmers. Traits are being utilized in Australia that would likely put a Canadian breeder into a novelty situation. This means that while Australian farmers are benefiting from these traits, Canadian farmers would not be able to under the old policy, even if they were bred through traditional means.

[2] The European Food Safety Authority defines New Genomic Technique (NGT) as "breeding techniques that alter the genetic material of plants, animals or microorganisms. They are used to design new traits of interest or enhance or diminish existing characteristics of an organism" and are also referred to as precision breeding. (European Food Safety Authority, 2025).

Under the new policy framework, Canadian breeders will be allowed to target traits similar to those seen on my travels, and hopefully breeders will quickly be able to catch up to the gains already made in the countries that Canada competes against, like Australia.

In Australia and in Argentina, I witnessed the trickle-down effects of their biotechnology regulations. Companies exist, employing people and adding to the economy, solely to provide editing or other technological services to the breeding community. These companies have expanded beyond their local focus, and now provide services globally given their developed expertise.

It's understandable that the public wants transparency in plant breeding – I don't think that is something many would argue against – but innovation cannot be held hostage by unwarranted fear. In 25 years, there still has not been a case in which a Genetically Modified Organism (GMO) was inherently more risky than crop varieties developed through conventional breeding (Hubert, 2020). Policy needs to protect people and the environment, however, it should not limit innovation, fall behind on scientific advancement, or impede industry success.

2.1.3 Writing policy that is inclusive to SMEs and new entrants

Because of the way plant breeding has evolved in Canada – either though academic/government systems or as large, well-funded private companies – much of the policy is written with their interests, and not small businesses and start-ups, in mind. SMEs and start-ups are unlikely to have the reach or the resources of either group to lobby government, influence policy, or survive lengthy and costly overregulation, however they can still be very valuable in developing varieties for advantageous traits, as seen on my travel to SME breeding companies in Australia, USA, Argentina, New Zealand, and the UK. As such, they are important stakeholders to consider when developing and updating policy.

The old Part V policy, somewhat ironically, created an additional issue for new breeders and scientists attempting to develop their own breeding pipelines: they weren't in the industry long enough to independently prove their traits. Under the old Part V policy, the definition of

"new" is anything not in cultivated populations prior to 1996. It was an arbitrary line drawn to distinguish 'old' from 'new', with the onus to prove that the trait existed on some previous date being the responsibility of the plant breeder. Expectedly, many new breeders would not have had a connection to the industry in 1996, being forced to rely on their competitors or external data (even though there are no public repositories for traits for every species that existed in Canada in 1996). Competitive advantage resided with those breeders in programs whose pipelines were developed prior to 1996; in 2023, that was 27 years ago. The removal of this date for trait novelty is a welcome change that will decrease the competitive barrier faced by new entrants into the plant breeding industry, although the stifling of competitiveness and innovation will linger for decades.

Policy can inadvertently create a scheme that is prohibitive to competition as it acts as a barrier to entry, something extremely dangerous for any industry. As such, policy should be reviewed often, and in plant breeding at least every 10 years, to ensure no competitive barriers for particular groups are developed or reinforced by policy.

It becomes a chicken or egg scenario: having more SME and start-up companies would make the issues faced by independent breeders relevant, so regulators would write policy to remove barriers, but without barriers being removed SMEs and start-ups will struggle to compete and exist. How do we adequately identify and address the barriers to entry (real and potential) for an industry segment that hardly exists in order to grow that segment? It's something that will need to be addressed for the success of SME and start-up plant breeding companies in Canada.

2.1.4 Developing consistent biotechnology policy globally

Developing consistent biotechnology policies globally is advantageous for Canadian plant breeding start-ups and SMEs, as it is for all Canadian plant breeders. The starting point is ensuring that regulatory bodies are aware of issues arising from differences in regulations from one country to another, and how these differences will cause issues for breeders, marketers, processors, and product developers currently and into the future.

I encountered an interesting example of incongruent biotechnology policy in the UK: If a breeder in Canada creates a wheat variety using a biotechnology tool, then the grain of that variety is sold to the US to be processed into a cookie, and that cookie is intended for consumption in the UK, what restrictions does the Canadian plant breeder need to be cognizant of? A boost will be achieved in trading partners coordinating, or attempting to coordinate, biotechnology policy so that breeders do not have to restrict varieties from certain regions, and downstream companies do not have to take steps, such as avoiding purchasing mass lots, to ensure that their product does not contain an ingredient from a gene-edited product that doesn't meet their region's regulations. A standardization of policy will allow Canadian plant breeding start-ups and SMEs to be innovative in their research by creating certainty that their varieties will be commercially desirable and accepted in multiple markets. Innovative breeding programs releasing varieties that are barred from entry into profitable markets will not survive.

2.2 Registration Delays

2.2.1 Seed Regulatory Modernization

The CFIA announced its intention to modernize the *Seeds Regulations*, which was to begin in the Fall of 2020 (Government of Canada, 2022). One topic covered during this modernization, which was also repeatedly identified as a barrier for Canadian plant breeders during this study, was the onerous and imbalanced variety registration procedures in Canada.

The inefficient registration system could prove a barrier to entry for new entrants for several reasons:

1. The costs of an additional two years to revenue, in a field that is already so long to get to a revenue-generating situation, could bankrupt a start-up, and the industry could lose out on additional traits of interest and competition in the development space.
2. Merits developed by one or two breeding programs could block new entrants from entering the system. If merits were created in reference to a limited number of programs, and new programs have another set of objectives that don't put importance on the current merits, their varieties, although desired or needed in the marketplace, could have difficulty getting registered.
3. Competitor breeding programs are often running the registration trials, which may create issues if the competitors are not acting in good faith. Competitors may also have additional votes in the decision-making process, and these votes could be used to negatively impact the interests of new entrants if players are not acting in good faith.

2.2.2 Variety registration causing delays

The registration of varieties in Canada is split into three different parts, or tiers, depending on crop-kind and requirements for registration. Many major broadacre crops grown in Western Canada - including pea, lentil, wheat, barley, oats, flax, dry bean and canola - fall under Part I,

requiring pre-registration testing and merit assessment, as well as the basic requirements[3] for application for variety registration (Government of Canada, 2023). Logically, the requirement for pre-registration testing (which is then followed by further post-registration testing) adds unnecessary delays to the registration of varieties. Canada's pre-registration trials requirement can add up to four years for some crop-kinds and doesn't necessarily offer any additional benefit over Part III registration in many cases.

The time it takes plant breeders to get certain types of crops to market in Canada is significantly longer than in other areas of the world, including our cross-border neighbour and direct competitor, the United States (SaskSeed, 2022). The UK requires two years of VCU (value for cultivation and use) trials prior to varieties being added to the UK's list of registered varieties, the National List (UK Government, 2024), however other countries I visited, like the US, New Zealand and Australia, have no similar requirement according to breeders visited in these countries (I note that this is not referring to PBR/PVP/DUS or post-registration comparative trials). Revenue collection in plant breeding inherently takes a long time due to lengthy development timelines. Streamlining registration procedures to have varieties released sooner would decrease the barrier to entry for new breeding groups by reducing costly time delays to revenue collection. This would also assist farmers in getting traits of interest as soon as they become available without posing additional risk to farmers and consumers.

To remove some of the existing delays to registration, regional comparative variety trials (RVTs) can be completed after, or during, registration. In fact, RVTs exist for many crops of interest in certain regions and are either distributed through seed guides[4] or through direct data publication[5]. These trials are often large, accessible to all breeders, and include commercially

[3] Basic registration requirements include an application containing a proposed variety name, the scientific and/or common name of the species, a complete description of the pedigree, origin, history and methods of development of the variety, a detailed description of the variety (including, where applicable, morphological, pathologic, agronomic physiologic, and biochemical characteristics), a commercialization statement, information on the maintenance of seed stocks, information on the Canadian representative, a breeder declaration, and a representative seed sample. Some species have additional requirements (Government of Canada, 2023).

[4] An example of a regional seed guide is the Saskatchewan Varieties of Grain Crops Guide, accessible at: https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/crops-and-irrigation/crop-guides-and-publications/varieties-of-grain-crops.

[5] An example of direct data publication is the Saskatchewan Pulse Growers' Pulse Regional Variety Trial (RVT) Portal, accessible at: https://saskpulse.com/resources/pulse-regional-variety-trial-rvt-portal/.

available varieties, not just two or three check varieties (common in the registration trials). The data from these trials is publicly accessible. Farmers, therefore, would be the adjudicators and choose whether they want to take the risk of growing a variety that has only been in the trial for a year or two, or if they want to continue to observe the variety before growing it themselves. The decision is up to them.

With varieties that are only slightly more advantageous than what is currently available on the market, it may not seem significant that farmers will have to wait the additional two (or more) years as the variety moves through the registration process, however this delay is detrimental to the entire seed industry when beneficial innovation has occurred. For example, what are the consequences if there is a major disease-resistant trait, such as Aphanomyces root rot resistance in lentils, that is developed in a variety and the Canadian marketplace has to wait for at least an additional two years to access the variety, whereas American farmers would be able to access it as soon as the seed is available? What would the economic impact of this be, not only to individual farmers, but to the agricultural industry as a whole?

2.2.3 Impediments due to heavy-handed merits

In addition to the impediment and financial costs of delayed registration, more attention needs to be paid to the requirements of the registration process. Standards, or merits, are important to ensure that varieties are up to par. However, niche markets and markets where certain merits are not as important or not relevant (for example, a disease resistance in an area that is not inflicted with the disease) may lose out on traits that are important to them if varieties are not registered because they don't have an enumerated merit. Merit requirements need to make sense and not pigeon-hole all varieties into the same type. For instance, should a variety that yields more and is intended for a non-edible oil market be required to contain a previously prescribed level of a certain amino acid to be registered? Further, should beneficial varieties be blocked if susceptible to a disease that is controllable through stewardship means? Expanding the traits available, even when certain merits are not present in a variety, benefits innovative breeders and allows sophisticated farmers to make the best decision for their operation based on their geographical location and intended markets.

2.2.4 Potential improvements to Canada's varietal registration

When travelling in Uruguay, a sign on the Seed Association of the Americas office wall read 'the most dangerous phrase in the language is "we've always done it this way."' So far, that is the best reasoning I have received for why Canada's regulatory system is being run as it is. We need to ask ourselves multiple questions about Canada's varietal registration process: Is the current system actually acting in the best interest of agriculture and farmers? How can we make the system efficient? How can we ensure it is not used as a barrier to entry to new entrants?

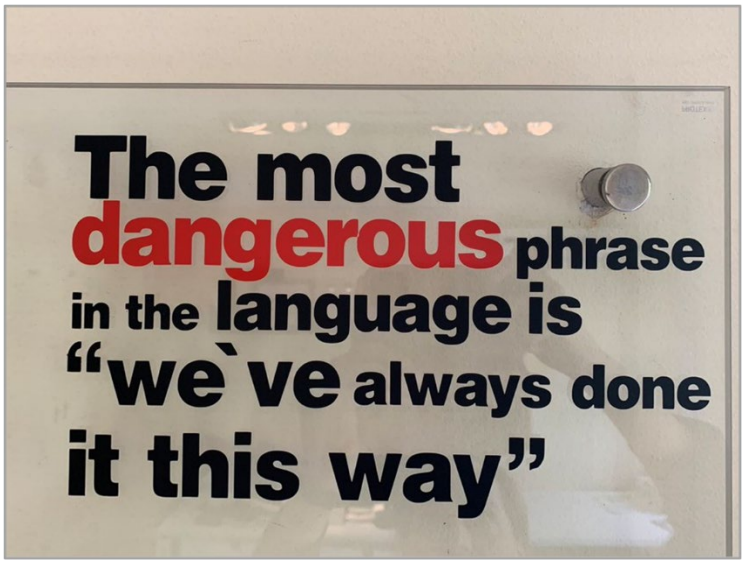

Image 2: A pertinent sign on the wall of the URUPOV office in Uruguay during my visit in March, 2022.

There are crops in Canada, such as hemp, sunflower, canary seed and chickpea, that are registered under Part III, which requires only basic registration criteria (Government of Canada, 2023)[6]. Additional crops could be moved into this tier, but there is not a simple, efficient way to do this. A system where every crop starts in, and is regularly reviewed for return to, Part III might

[6] Crop types are divided into three tiers with varied requirements for registration. These requirements include:

- Part I requires pre-registration testing and merit assessment (see Glossary section B.7 for a definition of merit), as well as the basic requirements for applications for variety registration
- Part II requires pre-registration testing as well as the basic requirements for applications for variety registration
- Part III requires basic registration requirements only (Seed Regulations, 2024).

make sense. In this situation, stakeholders would vote to increase the requirements and move the crop to Part I. Currently, the stakeholders' vote can move a crop to a less restrictive tier, however that may be a competitive disadvantage for existing agencies and the vote may be strategic. We need to ask questions such as: Who are the stakeholders? How many votes does each stakeholder get? And how does a new entrant not get unjustly blocked in this system by the competitors that have voting control?

To date, most variety registration has been done by public institutions, particularly in Western Canada. The drive to increase the efficiency of the registration system may not be a priority for public institutions that are funded through means other than revenue from seed sales or royalties. However, for a private company, delayed registration caused by inefficiencies in the process will result in economic harm from delayed market-entry and may trigger business failure. Losing businesses, and the competition and innovation they contribute, would negatively affect the entire industry. For private plant breeding to succeed in Canada, a review of the delays and inefficiencies created by the current variety registration scheme should be conducted and the bottlenecks and inequality should be addressed.

2.3 Intellectual Property and Royalty Collection

2.3.1 Intellectual property protections in Canada

Varieties in Canada can be protected through Plant Breeders' Rights (PBR), a form of intellectual property rights that grants the holder exclusive rights to the propagating material of their variety (Government of Canada, 2015). These rights were enshrined to help breeders protect their innovations, with caveats such as the Farmers' privilege[7] and Breeders' privilege[8] to enable sustainability of genetic resources and allow innovation to continue (Bruins, 2017).

[7] In the *Plant Breeders' Rights Act* s. 5.3(2), Farmers' privilege releases farmers from certain parts of the Act stating:

> The rights referred to in paragraphs 5(1)(a) and (b) and — for the purposes of exercising those rights and the right to store — the right referred to in paragraph 5(1)(g) do not apply to harvested material of the plant variety that is grown by a farmer on the farmer's holdings and used by the farmer on those holdings for the sole purpose of propagation of the plant variety (Plant Breeders' Rights Act, 2024).

[8] In the *Plant Breeders' Rights Act*, the section that is colloquially referred to as the Breeder's privilege is discussed in s. 5.3(1) where the rights referred to in specific earlier sections of the Act (namely 5 to 5.2) do not apply to any act done:

> (c) for the purpose of breeding other plant varieties (Plant Breeders' Rights Act, 2024).

Image 3: Visiting WIPO, the World Intellectual Property Office in Geneva, Switzerland, that houses the UPOV Office in November 2021.

From my travels in Uruguay, Australia, and Switzerland, one thing became quite clear: Canada's PBR Office is well respected and often advises countries developing their own intellectual property (IP) structure. While modifications, additions, or clarifications need to be made to keep PBR up-to-date internationally, the reputation of the Canadian PBR system is something to be proud of. That said, what seemed confusing to my international peers was that Canada has yet to take full advantage of the update to Canada's PBR to conform to UPOV '91. This is more in reference to the Canadian broadacre agricultural system, as the Canadian horticulture and ornamental systems have utilized PBR with greater success (Zienkiewicz, 2025; AAFC, 2023).

A recently released report "Assessing Impacts of the 2015 Legislative Amendments to Canada's Plant Breeders' Rights Act and UPOV'91 Ratification" highlights eight case studies showing the positive impacts of the *PBR Act* amendments in Canada. It also includes a survey with comments on the amendments, with one commenter stating: "It's all about how we put the

framework into action" (AAFC, 2023). To date, Canada has not put the framework into action in grain crops to the extent necessary to see large benefits to competition and innovation.

2.3.2 Royalty collection in Canada

The *PBR Act* provides a mechanism for breeders, breeding companies, and breeding institutions to receive royalties for their investment in the development of a variety. The certainty of these royalties would encourage additional investment and research into varietal development (Lassoued and Smyth, 2022). So why has the Canadian plant breeding industry not utilized the PBR system in broad-acre grain agriculture? Perception? Slow uptake? Are we culturally not receptive to IP rights in general? All of these reasons came up as considerations in discussions during my international travels.

While in Uruguay, I met with Diego Risso, executive director of the Uruguayan Plant Breeders Association (URUPOV), to discuss how Canada can advance to the Uruguayan level of breeding security and sustainability. Diego is aware of Canada's current laws. He acknowledged that Canada's Plant Breeders' Rights are more secure than Uruguay's, but Uruguay is better able to translate their rights into a system that works for both farmers and breeders. He echoes the concern that Canada may never get to Uruguay's level of protection as there are too many contradictory voices to reach the consensus necessary to take action. He made a comment that has remained with me since this Nuffield trip: stop advocating for the need for royalties to make better varieties. Diego's point was that, even though it is true that royalties are needed to make better varieties, this argument has not been successful in convincing farmers that a royalty collection system is necessary as 'acceptable enough' varieties continue to be released without royalties. He recommends that Canada needs to find a different message to convince producers to buy into the royalty system. Although very frustrating to those who seek more competitive varieties, and appreciate that more competitive varieties are achievable within a royalty system, I understand the argument may need to change because continuing to say the same thing and expecting different results is illogical. But the question is, what should the new message be? If 'we need royalties to develop competitive varieties in Canada' isn't enough to have Canadian agriculture accept we need royalties, what is? Where do we go from here?

In Canada we are already seeing how changes in public funding be largely detrimental to variety development, such as the closure of the Agriculture and Agri-Food Canada's (AAFC) flax breeding program in 2014 and the cuts in funding to public plant development and research from Alberta Agriculture in 2021. Breeding programs build upon themselves, so funding instability can cause the end of programs, resulting in the loss of all the previous efforts, progress, and innovation. Royalty collection, would help insulate and stabilize breeding programs, both public and private, from changes in research funding.

Royalties provide an avenue of stable income for breeding programs. Although they do not help start-ups or public programs launch, they allow them to continue to be successful and insulate them from potential shifts in public funding priorities. The expectation of a return on investment also makes funding arrangements, such as bank loans or third-party investments, both possible and more palatable. In Australia, New Zealand, Argentina, the USA, and the UK, I witnessed breeding programs that are economically independent, a benefit for them and the industry.

So, what would royalty collection look like in Canada? Several royalty collection mechanisms exist globally and have been summarized in different research reports, including an overview by Gray and Bolak (2014) and a Nuffield report by fellow scholar Crosby Devitt (2012). All royalty models have their strengths and weaknesses, and require improvements after being put into use. That said, the general feeling, and one of the main take-home messages from my travels, is that the worst option is not having a mechanism at all.

Globally, many are optimistic about the future of private breeding because of the many ways to run programs that have been unexplored by public breeding, the diverse funding opportunities, and the multiple ways to divvy up the breeding chain. I was repeatedly warned during my travels, however, that the likelihood of private plant breeding success in Canada was low, if not impossible, without a royalty system for the inbred crop-types. In discussions with newer private plant breeding start-ups internationally, I was cautioned against starting a private company in Canada – Canada does not currently have an industry-wide accepted royalty collection system and a company would not survive without it. Competition is needed in many crops in Canada, both because the public breeding programs are ceasing to exist and because

competition encourages the efficient development of innovative varieties. Without royalties, some crops may lose most or all of their breeding programs.

2.3.3 Program funding vs project funding

A consistent message was that funding of breeding programs, whether public or private, start-up or established, is most beneficial when the funding is program-based, not project-based. Project funding focuses on singular issues, and does not contemplate the long-term goals associated with program funding (Alonzi, 2024). Project funding is particularly difficult in plant breeding as breeding programs have many different and evolving objectives, and the time horizon for success is often several times the length of available project funding. Also, many project funds come with stringent budgetary constraints and often do not include all necessary components of a breeding program, such as capital expenditures for equipment like seeders or tractors.

Program-based funding has been implemented successfully in Australia and Argentina. Breeders in both locations said the format was necessary. With program-based funding, objectives are defined within their system, but the flexibility that exists allows breeders to be strategic in moving resources to objectives that are more likely to be commercialized. This flexibility allows the program to build a breeding pipeline with a more complete structure than if funding was only project-based. Breeders relying on project-based funding, although thankful for the resources, recognize it will be difficult to build a full program that is sustainable while relying on sporadic, outcomes-based investments. It is understandable that funding sources may have limited ability to fund longer programs and may see shorter projects as a way to show progress, however alternative reporting and milestone formats should also be considered as meaningful key performance indicators to benefit startups and SMEs.

2.4 Public Perception

2.4.1 Public perception of private plant breeding

Canada has few successful independent plant breeding companies and most of those are in crop-kinds where the IP is controlled either genetically (such as hybrids), contractually (such as minor crops where it is possible to be vertically integrated), or through patents (such as GMO traits). Often, the private companies that do exist in Canada entered the market as large multinational corporations. In the other countries I visited, many different forms of private plant breeding companies exist – including start-ups, family-run plant breeding companies, seed companies that evolved plant breeding arms, and groups of industry stakeholders coming together to develop their own programs. In fact, while travelling in Europe, private companies are so common, it felt like the question of whether independent plant breeding companies can survive was too obvious to ask.

During my travels, it became apparent that differences in the perception of plant breeders, their importance in the industry, and the role of competition amongst breeders varied widely. Reports from Canada discussing the perception of plant breeding include statements such as “With private-bred seed, many argue most of the profits often go to company shareholders who may not even be Canadian” and “There is also a general feeling that private breeding programs, such as the ones for canola, soybean and corn, are very well capitalized, with excellent equipment and other resources, whereas public breeding programs tend to generally have resource issues” (Thein, T. 2017). It’s clear from statements like these that Canadians often have a very singular view of what private breeding companies are, informed by their (or the media’s) impressions of large multinational corporations, and haven’t considered that by restricting private plant breeding activities, smaller Canadian-based start-ups and SMEs will suffer disproportionately. The perception is interesting, as smaller entities are the same types of businesses that are prevalent throughout agriculture, especially in primary production.

Plant breeding companies formed in Canada, focussed on Canadian producer needs and using Canadian-developed talent, could thrive if the regulatory landscape is changed to allow for the success of these companies. While international companies will go elsewhere to advance

their programs, it is Canadian-born and Canadian-focussed companies that will suffer the greatest if there is no change in public perception.

2.4.2 Public perception of young people

The agricultural industry is struggling to change its perception of young people operating within the seed sector. A message from Garlich von Essen at the SAA Seed Congress in Uruguay in 2022 was that the seed industry doesn't have a strategic development plan for its people and needs to get better at attracting, developing, and retaining young talent. Varietal development, especially in Canada where there are so few and such long-held public breeding career positions, is no exception.

While in Zimbabwe at the Allan Savory Institute, we were taken to a rangeland and asked if we thought the site was healthy. After driving through northern Zimbabwe during the late stages of the dry season, and finally seeing a few green leaves on the big trees, a lot of people in our group affirmed that, yes, they did believe it was healthy. Our guide explained that they were more worried about this area than others because, although there were large, mature trees that were thriving, something was destroying all of the new growth and there would be no continuation of the tree life cycles if they could not get the younger trees to survive. The solution was not to cut down the older trees so new ones could grow, rather it was to figure out why the environment changed to prevent the young trees' survival. They believed that it was a change in the elephant migration patterns due to a new rail line that was causing the problem, and they set up camps so elephants would not use that same path over and over, protecting young trees and encouraging their growth.

Image 4: Our guide at the Allan Savory Institute in October 2022 discussing why the ecosystem was having such a hard time supporting young growth. Photo Credit: Amy Cronin, 2020 Nuffield Scholar.

Similar to the ecosystem in Zimbabwe, we might have to figure out why the seed sector lacks young people and how we can fix the problem. It is estimated that 40% of farmers will retire in the next 10 years (RBC, 2023). Young people will have to take leadership positions to fill gaps. Are we allowing young breeders to develop the requisite skills prior to this need? Private plant breeding, where young entrepreneurs can gain experience and push the envelope, might help.

3.0 CONCLUSION

If we continue to do things the same way they've always been done, how do we advance? How do we make changes to allow for a more competitive environment when those changes are being impeded? I think these are the questions that are continuously getting punted in the industry.

Competition is necessary for a healthy, innovative industry. For several crop-kinds in Canada, including flax, chickpea, and mustard, this competition in breeding does not exist; if the only innovation that occurs in these crops is further to the limited number of objectives that one breeding program can focus on, progress will be slow. The whole supply chain will suffer from the inefficient pace of innovation in the sector.

Private plant breeding is not being fully utilized in Canada, especially in inbred crop-kinds where intellectual property cannot be controlled through genetic systems. My travels made it clear that the development of the private plant breeding sector will enhance the breeding efforts in Canada and give Canadian farmers additional varietal options. That said, several barriers have to be removed to create a sustainable environment for start-ups and SME enterprises to exist and thrive in Canada.

Modern biotechnology regulations, efficient registration systems, a way to capture return on investment through intellectual property, and a change in perception of what is necessary for success in the seed sector are all necessary to develop a strong lane of private plant breeding companies in Canada.

4.0 RECOMMENDATIONS

To increase the likelihood of small and start-up private companies being successful, and to make Canadian plant breeding more competitive locally and, consequentially, globally, the Canadian agricultural industry should consider taking the following steps:

1) Have breeders involved in planning and updating relevant policy. Ensure all types of breeding programs are represented in equal numbers. Afterward, hold information sessions for breeders to ensure questions can be answered and misinformation corrected.
2) Remove barriers to entry by making a more efficient system for registering crops in Canada. Merits can be kept where the merits are appropriate and applicable, but it should also be possible to show these merits quickly and effectively. Certain crops, including those with less breeding competition, should be moved to Part III registration.
3) Create policy with as little grey area as possible to avoid confusion or risk that policy becoming a barrier to entry for new breeding efforts.
4) Develop a royalty structure in Canada so breeding programs can be self-sufficient and reinvest in continued varietal development. This will allow farmers to be able to vote with their dollars on the varieties that are successful.
5) Develop funding and business development programs to help new start-up breeding companies move from the concept stage to revenue generation to ensure multiple players exist in the event public funding systems are restructured.
6) Investigate why we are losing young graduates to other industries or to careers other than plant breeding.

A recommendation that was developed during my Nuffield travels that was completed during the writing of this report was:

1) Release an updated Part V of the *Seed Regulations*, allowing plant breeders to operate more freely and confidently, similarly to their international counterparts.

5.0 GLOSSARY

AAFC – Agriculture and Agri-Food Canada

GMO – Genetically Modified Organism

IP – Intellectual Property

PBR – Plant Breeders' Rights

PNT - Plants with Novel Traits

NGT – New Genomic Techniques

RVT- Regional Variety Trials

SME – Small and Medium Sized Enterprises

VUA – Variety Use Agreement

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