

CWAC and CSU Wheat Breeding – A Partnership that Works
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I have been asked by the CWAC leadership to describe the effects on our breeding program in the event of an unsuccessful referendum vote in March 2014. Before I comment about the effects on our program, I want to review very briefly where our program has been over the last 50 years since we began in 1963. While I have only been a part of this for the last 15 years (plus the 5-plus years as a grad student a few years back...), one thing is very obvious to me and should be obvious to many others – our partnership works.

Over the last 50 years, our wheat breeding and wheat-related research programs at CSU have played a leading role in bringing new products to market specifically tailored for Colorado's challenging environment. In the early 1970s, a selection made out of Scout wheat (named Baca) was released with improved adaptation specifically in Colorado. In the mid-1970s, our program was among the first to deploy semi-dwarf winter wheat in the Great Plains (first Lindon, then Vona). In the 1980s and 90s, we rapidly addressed challenges presented by the new incursion of the Russian wheat aphid (RWA). Through enhanced funding from CWAC, and, very importantly, the leveraging of support from the Colorado legislature that this enabled, we were the first in the US to release a variety with resistance to RWA (Halt). Several other RWA-resistant varieties soon followed (most notably Yumar and Prairie Red) and played significant roles in the most affected areas of eastern Colorado. In the early-2000s, we were the first in the US to release an herbicide tolerant CLEARFIELD wheat variety (Above) and we quickly followed this with the first winter wheat variety in the Great Plains developed using doubled haploid breeding (Bond CL). Through the mid-2000s, we released a suite of varieties (Hatcher, Ripper, Bill Brown) that together have dominated Colorado's acreage statistics and have gone a long way to erase Colorado's reputation as a poor-quality wheat state. In 2009, we released Snowmass, an extremely unique hard white wheat variety with end-use quality properties that favor its use in the rapidly growing whole grain foods arena. More recently, we released the varieties Byrd, which shows sizable yield improvements over our current dominant wheat Hatcher, and Brawl CL Plus, the first public two-gene CLEARFIELD winter wheat variety released in the US. Throughout our entire 50-year history we have consistently addressed the multitude of challenges facing wheat and wheat producers in Colorado, continually raising the bar for yield, stress tolerance, and pest resistance through too-frequent droughts and pest incursions. While we are proud of our accomplishments and the partnership that we at CSU have built with Colorado's wheat industry, the challenges facing us are daunting and there is so much more to do.

We often hear about technology and how we are experiencing a technology revolution in agriculture and plant breeding. For wheat, this revolution is happening right now, right before our eyes. In the face of staggering higher education cuts in Colorado since the early 2000s, support provided almost exclusively by CWAC has enabled us to increase our efforts and become a key player in this revolution. Since 2007, we have greatly expanded our field trialing system and we now have a multi-fold greater capacity in Colorado than all other programs combined. We have established an aggressive program in novel trait development (known as TILLING) with which we hope to create new products and technologies to benefit the entire wheat value chain from producers to consumers. We have

implemented several advanced breeding technologies, notably wheat DNA marker-assisted selection and doubled haploid breeding, with the goal of more rapidly developing superior varieties for Colorado's wheat industry. In fact, with support from CWAC, which again was used to leverage a significant funding match from internal CSU sources, we recently completed renovation of our own doubled haploid facility on the CSU campus. Finally, all of these efforts fit hand-in-glove with our efforts with a new breeding technology known as "genomic selection". This new effort hopes to exploit recent advances in next-generation DNA sequencing to accelerate the breeding cycle for wheat variety development and thus the rate of genetic gain over time compared to conventional means. There are a lot of really neat things going on at CSU right now and, with vital support from CWAC, it's a very different breeding program than when I assumed leadership of the program in 1999.

Given all of these exciting developments, all of which are made possible with CWAC funding, what would happen if it all were to stop and go away? Before I cut to the chase, I understand that some might argue that I have a "dog in this fight", that in some way I have a personal or vested interest in maintaining funding for our programs. In essence it is difficult for me to deny this, as I really enjoy leading this program and working on something that I feel can make a positive impact in real and tangible ways. It is exactly this desire to contribute to tangible outcomes that makes it easy for me to get out of bed in the morning.

So, what would our future look like if we were to go back to pre-2007 CWAC funding levels? This can be summarized in three words – people, capacity, and productivity. First, we have the best people anywhere in the world working at CSU in our wheat breeding program. They are not only committed but also passionate about making a difference for agriculture on the local, regional, and global levels. Specifically, three PhD-level scientists and two MS-level researchers, all funded 100% by CWAC, would be sent packing. Second, with their departure our capacity to implement new technologies and develop improved products would be immediately curtailed – work on TILLING, doubled haploids, marker-assisted selection, and genomic selection would all immediately cease. And let me be clear – no funding increases from CSU would step in to fill the void. Forget that. Lastly, as our people and technological capacity inevitably erodes we undoubtedly would see a corresponding erosion in our productivity. We would see fewer improved varieties, released less often, and collectively less able to help producers deal with the climatic and marketing challenges facing wheat in Colorado today. Some might argue that private industry would step in to fill the void left by our demise, and I expect that would be the case to a certain degree. I would argue, however, that both past history and the present state of other programs' efforts would suggest that they would largely emphasize addressing the needs in the larger production areas to our east (which was the reason the CO wheat industry started our program in the first place!). Our program works for Colorado.

There are tremendous challenges facing agriculture in general and wheat in particular in the US and Colorado. I am both proud and humble to say that the partnership that we at CSU have built over the years with the wheat industry in Colorado is second to none. As I said at the outset, it works. I have enjoyed very much serving the Colorado wheat industry for the last 15 years and can only look forward with excitement for what the future might bring.