

## Meet a Researcher – Dr. Santosh Kumar, Brandon Research & Development Centre

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Wheat products are a staple in diets all around the world. Most Canadian wheat consumers don't typically think about their food's backstory beyond picking it up at the local grocery store. They may be surprised to know that some of the wheat they consume doesn't come from that far away. Many of products you can find at the grocery store containing wheat are produced with wheat grown on Canadian farms. Canada grows some of the best wheat in the world so it's only natural that it is offered on our grocery store shelves.

Today, wheat is one of the most high-yielding, cultivated crops in Canada. However, the crop hasn't always been as successful on Canadian farms as it has been in recent years. Farmers have been growing wheat here for over a hundred years, over time they have learned how to tweak the crop to better suit the Canadian climate and weather patterns, as well as the pests and diseases that come along with it. Only in recent years has technology allowed the agriculture industry to grow the potential of wheat to a point that the predecessors of today's farmers could never have imagined. High-yielding wheat crops that are resistant to all types of damaging factors are now grown on almost every grain farm in Canada. So, who is the powerhouse behind this work?

Wheat Breeders.

Meet Research Scientist and Wheat Breeder, Dr. Santosh Kumar. Santosh works for Agriculture and Agri-Food Canada (AAFC) at the Brandon Research and Development Centre (BRDC), a leading facility in Canadian wheat research and variety development. He leads a team of researchers and research assistants who he describes as being "Jacks of All Trades" within the program. Santosh is very appreciative of the team he has and, in conversation, repeatedly emphasizes how much of the work done within the breeding program at BRDC is dependent on the foundation of strong teamwork.



*Figure 1 – Dr. Santosh Kumar standing in one of his wheat plots as his team spreads corn inoculate infected with Fusarium Head Blight (Photo: Kate Rodger)*

As important as teamwork is for Santosh and the program he is running, it still falls second in line to funding. Funding is *absolutely critical* for the breeding program to be able to operate. It's simple, without it, they cannot do their job.

“Everything is important but the support we receive from funding partners is the most important. The relationship we have with our funders is one of the best parts about the system. They hold us accountable – we need to get the work done,” Santosh explains. When driving by any BRDC research wheat plot, signs with a large title reading “CWRC” can be spotted. All of the wheat research that Santosh and his team at BRDC work on is funded by the Canadian Wheat Research Coalition’s (CWRC) Canadian National Wheat Cluster (CNWC) and AAFC. The CWRC is a collaboration between the Manitoba Wheat and Barley Growers Association (MWBGA), Saskatchewan Wheat Development Commission (SaskWheat) and Alberta Wheat Commission (AWC) aimed at improving the profitability of wheat for western Canadian farmers. Funding like this enables Santosh and his team to do their job to the best of their ability and invest in technology, both in the lab and field, that will make their job easier with more efficiencies.

Although the technology that facilitates the wheat breeding process has made variety selection much easier, this kind of selection is not new. Farmers have always been remarkably adaptive and observant of their crops, domesticating and selecting the best seeds to plant for next year. The only difference is that now we have the technology that allows us to speed up the process. Being able to study

the wheat genome and control the critical crossing and selection process has enabled scientists to make huge breakthroughs in variety development.

Today, many have unique ideologies about what wheat crossing looks like. It's probably not what they think. Some might be surprised to know how simple the crossing process truly is. Hint: Nature does most of the work. Nature knows what it's doing – sometimes it just needs a little bit of help!

Wheat plants *can* cross pollinate naturally to make seeds however, wheat plants usually self-pollinate. It rarely happens that a wheat plant is pollinated by another and if it does, it is not controlled the way that it needs to be in order to develop the specific varieties farmers need in today's economy and environment. With the help of humans and technology, the natural crossing process is much more precise and quick. Wheat inflorescence from one desirable plant are emasculated to retain the female reproductive organs only (see figure 2). Then the pollen from the male parent is sprinkled onto the inflorescence of the female parent (see figure 3). From this, new seeds will be formed on the female parent containing the traits/genetics from both plants. From there on, many cycles of selections are done to find that one desirable plant with all desirable traits which can become a variety that farmers will grow.



*Figure 2 – Wheat inflorescence is emasculated. Female reproductive organs are exposed. (Photo: Kate Rodger)*



*Figure 3 – Pollen from male parent being brushed into a bag containing the inflorescence of the female parent. (Photo: Kate Rodger)*

“Crossing followed by stringent in-field selection are the most crucial steps in the breeding process,” Santosh mentions. New varieties are developed every year because of the breeding ‘pipe-line’ which is kept full with germplasm from all fourteen generations processed each year. The selection process is based on agronomic performance, disease resistance and optimum quality attributes. It is a necessary step to determine which plants have the desirable traits that breeders are wanting for new varieties. Santosh stresses that the challenge with selection is that there are so many desirable traits they want to capture in one variety.

“The hardest part about breeding in comparison to other types of research is that we have to consider every aspect of crop improvement in one variety. It’s difficult to try and bring all of the good traits together into one variety that will be successful on Canadian farms.” Santosh’s breeding program at BRDC focuses a lot of their time on Fusarium Head Blight (FHB) research and variety resistance to Orange Wheat Blossom Midge. FHB is a fungal disease that affects cereals, especially wheat, and can cause the development of a toxins within the seeds. To find a plant that is resistant to FHB, the plants must be infected with FHB in the research plots during the growing season and selected around harvest. Only plants that survive the disease pressure and exhibit resistance to the disease will be selected.

Breeding any crop is a very long process. It can take up to fourteen years to get a wheat variety registered for use in Canada. Although the work is hard and the process is long, any breeder will tell you that it’s all worth it when you get to see the positive impact your work can have on Canadian farms. Santosh reiterated this when asked why he chose to become a wheat breeder,

“I wanted to become a breeder so that my work could make a real difference. It’s so rewarding to see how the varieties we develop make a positive impact on the lives of farmers and Canadian agriculture.” The new Canada Western Red Spring (CWRS) wheat varieties from Santosh’s program are AAC Cameron (Canterra), AAC Jatharia (SeCan), AAC Warman (SeCan), AAC Magnet (FP Genetics) and AAC LeRoy (Alliance Seeds). The most recent early maturing CWRS from Santosh’s program is AAC Redstar (SeCan) and should be available to farmers in the next 3-4 years.

**If you are interested in learning more about the wheat breeding program at BRDC, please make plans to attend the 2019 Brandon Research and Development Centre Oat and Wheat Field Tour on Thursday, August 8<sup>th</sup>, 2019. There will be a breeding overview, tour of disease nurseries/yield trials and small plot equipment demonstrations. Farmers are welcome to attend! Please RSVP to Kali Stewart by email or phone at: [Kali.Stewart@Canada.ca](mailto:Kali.Stewart@Canada.ca) or 204-578-6695.**

*Some projects that are a part of the **Canadian National Wheat Cluster (CNWC)** which Santosh is currently leading and co-leading include: Development of Canada Western Red Spring Wheat Varieties for the Eastern Prairies of Canada, Development of Canada Western Spring Wheat Varieties for the Northern Prairies of Canada, Improving Fusarium Head Blight Resistance in Bread Wheat, Finding Additional Sources of Resistance for Orange Wheat Blossom Midge in Bread Wheat Germplasm, Pre-Breeding in Bread Wheat for Enhanced Biotic and Abiotic Stress Tolerances, and Improving Grade Protection in Bread Wheat Through Pre-Harvest Sprouting Resistance. The Canadian National Wheat Cluster funds multiple other projects at other facilities throughout Canada. The funding will address common issues that farmers face and will lead to improved varieties and agronomic practices.*

*For more information on the CNWC visit: <https://www.wheatresearch.ca/wheat-cluster>.*

*As posted on Manitoba Wheat and Barley Growers Association Website*