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Company Affiliations: Government of Canada—Department of Agriculture and Agrifood: Semiarid Prairie Agricultural Research Centre (SPARC)

Interview Date: 19 June 2013

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Summary: Senior wheat breeder at the Semiarid Prairie Agricultural Research Centre Dr. Ron Depauw discusses his career in the grain science sector. He begins by describing his university research work in wheat breeding through a Canadian International Development Agency study in Kenya. He explains the history of wheat breeding in Canada, like the development of Marquis wheat by the Saunders family, and explains the broad history of wheat domestication and evolution. He also describes Canada's rapid technological innovations in grain farming, handling, and transportation. Depauw then discusses his work as a senior scientist developing grain breeds that are high yielding and disease resistant. He lists common grain diseases, describes how they spread, and explains the scientist's job to stay ahead of disease mutation. He shares stories of successful wheat breeding developments that have contributed to Canada's continued success as an exporter. Other topics discussed include the constraints of bureaucracy on science, Canada's unique grain variety registration system, various organizations that oversee grain variety registration, and the steady cooperation among organizations in the realm of grain research.

Keywords: Government of Canada—Department of Agriculture and Agrifood; Semiarid Prairie Agricultural Research Centre (SPARC); Grain research; Grain science; Wheat breeding; Plant breeding; Prairie Province history; Wheat domestication; Wheat evolution; Wheat varieties; Marquis wheat; Grain farmers/producers; Grain transportation—rail; Grain transportation—ships; Farming—equipment and supplies; Grain diseases; Grain pests; Grain rust; Plant genetics; Invasive species; Protein testing; Grain trade—Laws and legislation; Seed variety registration; Canadian Grain Commission (CGC); Canadian International Development Agency (CIDA): Canadian Food Inspection Agency (CFIA): Canada Seeds Act; Canada Grain Act; Experimental Farm Act

Time, Speaker, Narrative

NP: It's June 19th, and I've made my way to Swift Current, and I am very pleased to conduct this interview today. I'll have our narrator introduce himself, where we are, and what his job is.

RD: I am Doctor Ron Depauw, senior principal wheat breeder here. I'm with Agriculture and Agrifood Canada, located at the Semiarid Prairie Research Centre, which is headquartered in Swift Current, Saskatchewan.

NP: Great, now did I--. Yes, I did say it was June 19th. I usually like to start the interviews by asking people how they got interested in, I'll call it, the grain trade. I don't know if you consider grain research part of the grain trade, but in my mind, without it, the trade stagnates. How did you first get interested?

RD: I was born on a farm near Kamsack, Saskatchewan. The little community was Veregin, and my parents then moved to Southern Manitoba and continued farming on a farm between Treherne and Holland, Manitoba, which is along the Highway No. 2. I grew up on a farm and participated in a 4-H seed club, where we grew pedigree grains of new varieties, and we had a mixed farm of livestock, cow calf operation. We'd graze litters of pigs during the summertime as a learning opportunity for the kids, and we'd have chickens and some roosters and things like that. So, it was very much a family farm that I grew up on, and, of course, my parents raised the children to become full members of the family operation. You felt, even as a kid, that you were contributing to the operation. So, you learned a lot about self-reliance, independence, thinking for yourself.

I went to university not really knowing what I was going to do, but because my brother-in-law was in physics and was doing very well, as well as my older sister, that was the only thing I really knew, and I was doing well in science. So, I thought I'd do that, so I engaged in an honour's science program at the university. Things evolved and changed and eventually I did a master's in agriculture and really enjoyed agriculture very much.

Once I got into genetics, it was obviously fitting right into an area that I felt extremely comfortable with. So, my master's was on plant breeding technology and statistics with how to develop better technologies for the developing better varieties of wheat. As I was finishing my master's degree in 1969, Len Shebeski, who was the dean at the University of Manitoba, approached me and asked me if I would consider going to work on a seed project overseen by the University of Manitoba in Kenya, East Africa. I thought about it and replied sometime later that, yes, I would do that, because this I knew that the Canadian researchers were working from Canada that were working there were senior researchers and that this Wheat Project in Canada, that obviously they were doing research that surely there would be some aspect of this research I could use to qualify for a PhD. So, I took that back to Dr. Len Shebeski, and he said yes with the understanding that the research would be of benefit to the Kenyan wheat industry and would of course be the requirements for a PhD. I had the good fortune then of about 20 percent of what I was doing in East Africa was focusing on the study of adult plant resistance, or what is now called gerbil rust resistance, and brought that research

back and qualified for my PhD. It was just a wonderful experience living in East Africa, doing research that was relevant to the local wheat industry, and that I was able to, at the same time, contribute to new knowledge.

When I came back to Canada, I wrote that up, and during the course of that year, I was offered a series of jobs, one was with DR, Development and Research Corporation of Canada, and that was located in Ottawa. My wife and I decided not to do that one because getting involved in too much travel. Then there was another position in Ottawa, decided against that one, but we decided to go to Beaverlodge, Alberta, to start our life, which is in the Peace River Region of Canada, because this would be an opportunity for us to start and focus on a life together.

My wife, the person I married, I met in East Africa. Her name is Elsa Marie. She worked in East Africa through the Danish volunteer organization. So she was giving up her language, and her family, and her traditions. So, when she came to Canada, she did not want to be married to somebody who was turning around and often everywhere else. We wanted to have a life together, so we went to Beaverlodge, Alberta and started there and then in--.

NP: What was in Beaverlodge?

RD: An Agriculture and Agri-food Canada Research Station. Then I was hired to start up a wheat breeding program—they didn't have one—so to start up a wheat breeding program, as well as a canola. So I was working halftime on canola and halftime on wheat. Then after five years there, and I knew more about agriculture and wheat breeding opportunities in Canada, my wife and I decided to come to Swift Current, Saskatchewan, because this was the best place in Canada to be breeding wheat.

I would like to share that without innovation there would be no competitiveness, without innovation there would be no grain trade, without grain trade, Thunder Bay would be very different than what it became. Without research there would be no innovation. So, my cornerstone that I would like to bring to this discussion on Voices of The Grain Trade, that research has been a fundamental element.

NP: I'm glad I don't have to pull this out of you. [Laughs]

RD: When you go back 150 years, it was very, very different. We owe a great deal of debt to those who were the stewards of the land before. I don't think that they have been treated entirely honourably. A whole way of life was taken away without, I don't think, adequate consideration. There were some people who thought that they would like to build from nation to nation. There were some people who came, and there was a king who granted some other people rights to all of the water that drained into the Hudson's Bay Company. That's pretty powerful stuff that somebody in Europe can do about another nation. Yeah, so there were

many, many things that occurred and changed. That having been said, they wanted to build, populate, this region to the west and of course, we know that the civil war had just ended in the United States. They had the largest standing army, so there were concerns about American expansionism.

There was information, knowledge about what was happening in the southeastern part of Mexican territory—the Texas, Oklahoma, Colorado, New Mexico, California, all that way, Utah—so there was a lot of concern in Ottawa, and of course England, that the West would be populated to counteract, to have something out here. If you're going to have people out here, you're going to have to have economic activity. What are they going to do? How are they going to feed themselves? How are they going to buy, educate, et cetera? So yes, they built a railroad across the nation, land to land, from coast to coast, encouraged people that were in a pretty tough situation in Europe with great promises to come and settle the land, but they needed economic activity.

Also, at about that time in the industrial revolution that was occurring, we now had power, industrial power. So that instead of using waterpower and stone mills to grind meal for food, there was power. There was also steel roller mills that could be used and another group had developed an air classification system, so you could now mill wheat. But wheat that is soft kernelled mills very nicely on the stone ground mills but is very poor for the industrial milling with steel roller mills. So, there was a need for a completely different kind of wheat. And the other thing about wheat is that it transports safely. It doesn't spoil. If you keep it dry, keep the insects out, you can store for a long period of time. You can transport for a long distance. To address this, William Saunders was hired by the Canadian government of that day to establish an experimental farm system to be able to help develop the farming systems for these people that were going to come and were coming.

NP: When approximately was this?

RD: 1886 the Experimental Farm Act, and he was charged with developing a wheat that could be grown on the Prairies and could be transported to markets at a price to the farmer that grew it and would cover all of the cost of the transportation.

NP: Can I ask a question about that? I don't know how much detail you plan to go into about it. But what is it about wheat—and I imagine wheat was the major production then—what is it about it that makes it transportable or not transportable? I understood the milling issues but not the transportation issues.

RD: How far can you transport something that is a high-water content? Like tomatoes, or lettuce.

NP: Especially sitting one upon another.

RD: Yes. How far can you transport meat? What do you have to do to transport meat? What did they do when there was the sailing ships? They had to be either live or they were in salt because they didn't have fresh fruit or vegetables. They don't transport. You've got to have refrigeration. Refrigeration is a development. It's a big component of transportation in our food industry, but that developed after the Second World War. Wheat, if it's dry--. I've got to go back a little bit further. About 10,000 years ago, wheat was beginning to become domesticated. The people would collect the seeds off of the wild grasses for eating them. And where they were doing that is in what we call the Fertile Crescent of the Middle East. It most likely would have been the women that were the ones that did the gathering, while the guys, the herds.

The first grasses that they were collecting, the seeds on the spike, would break off and fall to the ground, and the hulls remained attached to the grain. So, the harvesting was by picking the seed, these hulled materials, off the ground. Then they would roast them in fire to burn off the hulls.

There were two fundamental mutations that occurred in nature that likely women observed and greatly contributed. These are fundamental mutations that contributed to the evolution. Instead of what we call a brittle rachis, instead of the rachis breaking and the spike—that's with the seeds inside falling to the ground—they remain attached to the rachis, to the stem. Instead of having to stoop down to pick it up you could collect it standing up, and you would get a handful as opposed to one by one. It's a huge, huge, huge advantage.

The next major mutation that occurred in the domestication of wheat was the free-thrashing mutation. That mutation resulted in the outer coatings, the chaff parts, separating from the kernel so that you didn't have to burn it off. The gathering of food and the preparation of food was greatly enhanced. Those were two fundamental mutations that occurred naturally in wheat and contributed to the domestication of wheat and that occurred in the Fertile Crescent of the Middle East.

Because wheat has got a very balanced protein profile, and it's got starch in it, you can get your calories from it. When wheat is mature, it's at a low moisture content. You can store it. You can put it in a container and store it. It won't spoil like meat or like lettuce or tomatoes. These things will rot over the course of time. Whereas there it is, but you have to keep it dry, keep it free from the insects, and of course the locals learned that. Also, when they would go travelling, they would take some food. Wheat would be one of them. When they would go and trade with other peoples, this would become an element of trade. So then throughout the Mediterranean area, wheat is moving. In the Roman Empire, the wheat is moving. With the missionaries and traders, the wheat is going further and further around the world so that by the time you get to the 1700s—well, by the time you get to 1600 in America—wheat is being grown with Champlain and some of the early settlers that landed at Annapolis. That was around 1603. It was also being planted later around the early 1600s in Eastern Canada. It's primarily a food.

When they were developing the water system along the Ottawa River, wheat was a big thing that they had to provide as food. There was a demand. Also, if you go back to what was going on in Europe, they were in a food-deficit situation, and they were looking for food, looking for wheat.

NP: When was this?

RD: In the 1800s, 1860s, 1880s. When was the potato famine? The 1840s, the 1860s? So, there was a big demand for food. They had large famines, and they didn't have the food. So they were looking at North America and Australia as places of food. When we get to 1867, when Canada became, was, and then they wanted to bring in the Northwest Territories, which was the Hudson's Bay Company and do this expansion of the railroad, try to limit the expansion from the U.S. side or the evolving U.S. side, they needed to have people on the land. They needed to have economic activity, so they put in a railway to meet the requirement for BC to join, but you needed to have people on the land.

You needed to have an economic activity, so you need to have farming systems for them. That's where we get back to the Experimental Farm Act of 1886. William Saunders was charged with developing farming systems, and he thought that wheat would be one crop. There was demand in Europe, but it had to be able to pay for this big transportation. You had to move it from the Prairies where it was going to no facilities for a grain trade, at that point. There's no grain transportation system for grain, none of that. But they could move it by rail. It all evolved together, and that's what I think is so wonderful about the Voices of the Grain Trade putting together this history.

Okay, so now, William Saunders, let's go back to what he said. He said, "Okay, we need to have wheat that will mature within our short growing season, will pay for the cost of transportation, and obviously it has to meet the milling industry requirements." So now we've got an industrial milling situation, which you've mentioned about the steel roller mills and the power and then the air classification system. But the soft kernelled wheat doesn't fit that. So, they needed the hard kernelled wheat.

There was this wheat that was called Red Fife. It was hard kernelled and in the US. It was a Turkey, a red winter wheat, that was price-discounted because they were hard. But when we got into this industrialized milling, they went from being priced discounted to commanding a premium because they were hard kernelled, and they had really good milling properties for the industrial milling.

William Saunders assembled wheats through Canadian embassies and attaches from around the world and tried them out in experimental plots in Eastern Canada, Western Canada, various places. There was one Ladoga which came from the Lake Ladoga region of Russia--.

NP: Spelled?

RD: L-A-

NP: D-O-G-A?

RD: L-A-D-O-G-A, yes. And it was an early maturing one. It was hard kernelled. It was compared to Red Fife because the new Red Fife, the millers in Canada were liking Red Fife. They thought it [inaudible]. But Red Fife was just too late maturing, so they then did a test marketing of Ladoga wheat, and the test marketing of Ladoga wheat determined that Ladoga just didn't have the quality comparable to Red Fife.

Then William Saunders thought, "What we'll do is take this other wheat that had been growing called Hard Red Calcutta," which was a very early maturing one, one of the earliest strains that they had. They hybridized it, which means they made a sexual union of Hard Red Calcutta with Red Fife and generated **[*…audio skips*].** Enough crossing was done. They had planted their crossing block in Ottawa at Indian Head and Agassi, and I think also in Brandon. The cross of the hybridization of Red Fife and Hard Red Calcutta was done. They generated a whole bunch of progeny out of that, and William Saunders' son A.P. and the other son Charles Saunders evaluated the progeny of this cross of Hard Red Calcutta and Red Fife as well as other progeny, and they determined that, "Hm, there's one of these is looking pretty doggone good. It grows, it matures earlier than Red Fife, and it seems to have pretty good quality." And the determination of the gluten properties was done by a gluten test.

The gluten test was you take some kernels of grain, and you crush them with your teeth, and you make a gluten, like a gum. This was done by Charles Saunders who was a chemist. They'd also developed a mill so they had--. They also had a chemist working with them. But it was based on the chewing test. This wet gluten test was called the chewing test or making gum, if you want to make it really in everyday language.

I would suggest you have in your displays for kids wheat of different gluten properties where they can try to make gum. The hard red spring wheats will make a very different gum than if you have a soft, white spring. I think that would be a marvelous hands-on display. Also, I would suggest for your displays, you have little pup loaves, or real loaves, made from Red Spring wheat as

opposed to made from a Soft White Spring, that the gluten properties, the quality of the gluten or the quantity of the gluten or the protein, greatly impact functionality, and Walter Bushuk is the grandaddy of this kind of stuff.

To go back to the son, Charles Saunders, they had been growing some of these experimental lines that had been derived as progeny, as siblings, from the cross of Red Fife and Hard Red Calcutta at various places across Western Canada, and they found that one of these strains looked really promising. In 1908 then, they started distributing some samples of this to farmers through their experimental farm systems and hard-letter contacts and they got it out across to farmers. This particular strain was called Marquis. It eventually became Marquis. Marquis is then the first deliberately hybridized and selected and bred wheat variety in Canada. In the literature I have for you on the history of the grain trade, I've got the *World Wheat Book* and a review of wheat cultivar development in Canada with a lot of that information, and also what's called *Canadian Triticologists: The Game Changers.* You can have that, and this is William Saunders and his son. These are the things that have occurred since then.

NP: Those photographs that a accompany this, are they part of the collection here?

RD: Yes. This is some of what I've got. But here is Charles Saunders, okay? He was the breeder of Marquis. This is a quote from Newman in 1928, "Marquis, an economic fairy godmother to the industrial and commercial life of Canada, having built the whole economic structure of the Prairie provinces." This is from the Canada yearbook 1929, "In the late 1920s, wheat and flour accounted for one third of the dollar value of Canadian exports. In 1929, wheat was the number one economic activity of Canada, outstripping energy, forestry, and so on." The Canadian historian Granatstein, that's J.L. Granatstein, in *The Canadian 100: The 100 Most Influential Canadians of the 20th Century*, and I quote from Rawlinson and Granatstein's book, "He," and that's referring to Charles Saunders, "is entitled to stand first among the most influential Canadians of the 20th century." Another quote from J. Boyle, the U.S. Secretary of Agriculture, "The greatest single advance in wheat ever made by the United States was the introduction of a Hard Red Spring wheat known as Marquis. The idea came to us free of charge from Sir. Charles E. Saunders."

NP: So, in fact, it sounds as if they were trying to steal a bit of his glory?

RD: No, no, no, no, no. This is recognition of research that leads to innovation, that leads to economic activity, not only in Canada but also in the United States. This Marquis is foundational to our Canada Western Red Spring wheat. So any of our Hard Red Spring wheats that have grown in Canada and then moved through the transportation system to people around the world, you can trace them back to Marquis and of course Red Fife. I rest my case, Nancy, that without research there can be no innovation and innovation leads to competitiveness and economic activity.

NP: Now, so many questions. I have a question that goes right back to when you were talking about your African experience, and was CIDA with an I or with an E?

RD: With an I. It's the Canadian International Development Agency.

NP: Okay. Early on in this project, I started a collection of old postcards for Thunder Bay. When I did a Google search at one point, this one particular postcard came up. It was in the early 1900s, possibly around 1910, and it was a postcard from the coast of Africa. It was of storing grain in Africa. Now this was the same time that all of the major terminal elevators were being built in Thunder Bay and the railway system was, I think, had expanded to three railways at that point. The African one had big piles of grain sitting on a beach. Then we've got this massive infrastructure. I thought, "Why this method here in Canada and that method in Africa?" Tie that to your answer to your several comments about the importance of keeping wheat free from bugs. Why?

RD: And also rodents.

NP: Also rodents, yes.

RD: Okay in 1910, there wouldn't have been much wheat grown in East Africa. They were starting to do some of that in the settlement in the highlands and so on, but there wasn't--.

NP: Could it have been imported at that time and just dumped there because it was right on the shore?

RD: Yeah, right. I would've thought it would have been in bags. Was it maize? It would've been wheat for--.

NP: I didn't buy that particular postcard. I wish I had because it's been a central thought in my mind.

RD: Canada moved to a bulk handling system from quite early on, quite early on. If you look, Canada is unique in how far production is from tidewater. From Swift Current to Vancouver is about 1,700 kilometers. Swift Current to Thunder Bay is about 1,700 kilometers, and then you still got to go from Thunder Bay to Baie Commeau or wherever to get into the big ocean ships, so this is--.

Whereas if you go to Australia, the average distance from production to port is less than 300 kilometers. Hugely different, hugely different! For the United States, a lot of their grain, let's say, from the great central plains moves by water, which is kind of south

of Lethbridge. It moves by water on the Missouri River to the Mississippi River to the Gulf. From North Dakota, it's moving by water. It can also move by rail, I'm sure, but it can move by water, and water is much cheaper.

Of course, then you got Minnesota. It's on the water as well. Kansas wheat is moving by water and so on. If you go to the Ukraine and Russia, which is known as an exporter, well, they were using the Volga River, through the Black Sea, and going through the north prior to the Russian revolution. That area around the Caspian Sea and so on, where Ukraine is and all that when Canada wasn't. But they can do it by water. So Canada is—and of course I'm doing a little bit of hypothesis here—but I think Canada is unique. I think Canada is unique in how far we are from water compared to other exporters. You take Argentina, which is a big exporter, they're moving grain out through Marta Plata, which is on the coast and on the river system. They've got to move it by rail and trucks as well, but it's not to the same extent as what Canada is. I would encourage you folks to actually look at that. What is the average distance from production to water, moved by water, compared to Canada?

So that being said, in Canada the farmers were using horsepower quite early on and mechanization and using binders and doing stooking. Then the stationary thrashers. The grain was moving in wagons with horses. They would then take these wagons to where the rail was and a lot of these little towns are only about seven to ten miles apart, let's say, about fourteen kilometers apart or less. Why? That's about how far you could go with a team of horses. A wagon load of--. You had to have it close. And that was all by shoveling—so moving the grain by shoveling boxcars. They would be using some bags in very, very early stages.

I think I'm over my head on this because it's only my interest in this that I can speak about this and growing up on a farm. But that's where there should be a lot of emphasis. My expertise is on the research side and the genetics development of varieties. But they would've been using bags, and from bags they rapidly went to the building of boxcars.

I can remember as a kid loading--. Like taking grain to town in a one-tonne truck. That was in the late '50s. I was involved in hauling grain. I can remember hauling grain when I was in Grade 8. I can remember staying home to help the harvest when I was in 9 or Grade 10. I don't think it takes a rocket scientist to start wondering about if I had a driver's licence. That's how things were. You grew up being able--. I can remember being able to see the boxcars being loaded and the wooden boards being put in front of the doors and the grain being dumped in there because it doesn't take long to figure out that moving grain by hand is not very good, but rather to use power.

We were really good on the industrial development. All of these rigs to use power in substitution of labour. So why Canada went into the bulk handling system? I think it had a lot to do with Prairie or people ingenuity using power and developing devices, and I sure hope you get to include a lot of the stuff about the development of the tools like the grain auger.

The auger is a huge invention for--. I would say it's fundamental to move to a bulk handling system as opposed to--. I rode on a combine where they were using a bagger. Australia was using a bagger also, and I don't know when they were but certainly the baggers in Argentina as well. You won't find much about baggers in Canada. What is a bagger? A bagger, a bag, and these were for real people, they were 90 kilograms was a bag. So these are for real people to move, not wimps. The grain would come off the spout of the harvester into the bag. These would be jute bags. Then they would be sewn, and the bag then would slide down the shoot to the ground and then you'd have other people come along and pick up the bags and load them onto transportation devices, whether they were pulled by oxen or pulled by the combine. You've got somebody that is doing the bagging. You've got some more people that are picking up the bags and loading them onto wagons, taking them to storage facilities, and unloading them. So, you can see going to power and devices for bulk handling is, I think, quite an interesting evolution.

Okay, to get to the boxcars. The boxcars, as you know, off they go. Punch them open, dump them, you know. That's the Thunder Bay story. But it was just incredible. But the grain from the Canadian farms was rapidly adopted into a bulk-handling system.

Something else about Canada that is unique compared to, say Australia, in Canada we have always had extensive on-farm storage. Little granaries. They were little wooden ones, and then evolved to steel ones. In Australia it is just the other way. They have about ten percent on-farm storage, so their grain, right from the harvester, now goes into these big silos, and it's managed in the big silos then for the controlling of the insects and the drying formality. In Canada, it has our farming system has been about 90 percent on-farm storage with little wooden granaries evolving to the big ones. Now, you'll have 5, 8, 10,000-bushel bins, 20,000-bushel bins. There's very big bins on the farms now. Some of these other little wooden ones. Well, you might have had a few hundred bushels in them, 500-800 bushels in a wooden bin. **[*…audio skips*]** Research.

NP: Well, we should be speaking about research, but tied together and I was going to ask a question that sort of tries to tie them together.

RD: Are you going to the western development museums?

NP: No.

RD: Because I would really encourage you to go to some of the western developing museums. There's one in Saskatoon, one in North Battleford, and there's one in Moosejaw. The one in Moosejaw really deals with transportation. That could be a good one because it'll be dealing with the locomotive thing, and that is so important on the Prairies.

What I want to say, Nancy, about the work that I do and my colleagues do in research is to develop new strains of grain crops that can be successfully grown by farmers that will have better water-use efficiency, will have better nitrogen-use efficiency, will fit the different production systems to go far, summer fallowing to reduce tillage. These are all part of what we have to do to develop the different varieties to fit. And of course, we have to develop varieties that will resist the various pathogens of wheat.

Wheat is subject to diseases, which is no different than people being subject to diseases. For example, some of the diseases that will cause great harm to wheat are stem rust, which can outright kill the plant, leaf rust, which can cause anywhere from 20 to 50 percent yield loss depending on the severity of when it occurs. Stripe rust is another one, and there are other diseases like fusarium that not only causes reduction in the test weight and the kernel size, but they also produce a mycotoxin that is harmful in food or feed. Then you've got the spots and bugs, the bacterial diseases, and the viruses so you have to build in, we have built in genetic resistance to these diseases as opposed to having to use chemical control to control. So, it's a way to reduce production costs for the producers that are using genetic resistance built in as opposed to having to buy the chemicals to apply repeatedly. The genetic resistance is much more environmentally friendly than applying pesticides to the environment.

We've also built in genetic resistance to the wheat stem sawfly, which is an insect pest native to the grasslands of the northern plains. It was a number one insect pest that was controlled through genetic resistance by a team. More recently, genetic resistance has been built into the orange wheat blossom midge, again by scientists, as a way to control this insect pest as opposed to applying insecticides.

NP: With a few questions about that, are you always just keeping ahead of the next pest? Does building in genetic resistance just create resistance to, well, the majority of the population, not all the population, and then you have a resistance in the pests?

RD: It really depends how the pathogen evolves new variance to overcome the resistance genes that is in the wheat. Urbanites and everyone is familiar with penicillin as a way to control certain pathogens, human pathogens, and people are very much aware that the organisms will evolve resistance to penicillin. So, you have to come up with new strains. So, the pathogen has the capability to develop a new virulence. It's the same thing with the, let's say, the rusts.

There's a quote that says—I think it's from Norman Borlaug—that says, "The rusts never sleep." Yes, the rusts never sleep. They, the rusts, are the greatest threat to wheat. In Canada, the last big loss caused by stem rust was in 1953, and ever since then we've been able to stay ahead of the stem rust pathogens by building in new strains of genetic resistance to the evolving strains.

There was also a lot of work done in North America, particularly in the United States, to control the alternate host for stem rust and that is barberry. So, when stem rust goes through its sexual cycle on barberry, and when it goes through a sexual cycle, it can

then recombine genes from different strains of stem rust and then come forward with a whole new level of virulence combined together and then attack the wheat plant. So the barberry plants that are native to North America were controlled. They had armies of people going on out to find the barberry plants and kill them. So that was a major control strategy for stem rust, to reduce the evolution of new strains of stem rust.

But having said that, there was a new strain of stem rust found in Uganda in 1999 that had virulence on a very widely used gene called Sr31. The strain of rust that was found in Uganda in 1999 is commonly known as Ug99. So, it then spread to East Africa where there got to be a global concern about this because the stem rust resistance gene, Sr31, is widely used in the wheat strains throughout the Middle East, India, Pakistan, China into North America, Australia, and so on. In a few years' time, they found that this Ug99 strain, and in particular Sr31, could also take out Sr24.

The new strain that can take out Sr24 and Sr31 could take out about 80 percent of all the wheat varieties grown globally. So there was a big, big effort initiated under the Borlaug global rust initiative to combat stem rust before it spread globally, because if it moved from East Africa and then got into what they call the rust pathway—get into the Middle East, get over to India, Pakistan, China—it's on its way. It can get to Australia and so on, get to North America. And, of course, in Canada, we were in the same situation.

We had very few strains of wheat that were resistant to Sr31 and Sr24, so since then we have received extra funding from the federal government under a Growing Forward 1 program and a Growing Forward 2 program to combat Ug99 rusts. So yes, do the pathogens change? Yes. Can they do a lot of damage? Yes. That's why in the background there is this activity going on to control the pathogens before it gets to a crisis situation because you don't want a crisis situation.

NP: Does it spread by contact? Is it carried on the air? Can it be transported through shipments?

RD: In the case of stem rust, the reproduction structure of stem rust is a tiny spore and for this tiny spore, it's living, and it can't live that long, so it moves. It can be transported by wind. It can be transported by clothes. It can be transported by animals. It can be transported on grain. But it doesn't live very long. So, in order for it to live on, it has to infect. It must infect. It's obliged to infect living wheat tissue. The spore, the stem rust spore, must come into contact with wheat tissue. A stem, a leaf, green matter, living material.

NP: So, you'd consider green matter--?

RD: Pardon?

NP: Is the kernel itself considered?

RD: No, but it can be carried, you see. It can be carried. In order to infect, for the spore to infect, you need to have a susceptible wheat plant to this particular strain of stem rust, and you must have free standing moisture. So, there's three requirements. You have to have the stem rust spore with the virulence that will overcome the host, the wheat host that is living, and then freestanding moisture and a little bit of light also. But those are the three key ones.

But this spore, to be transported—that was part of your question—generally they're transported by wind, but you can also transport it on your clothes. So if you go from let's say, a nursery or a greenhouse where you've got some confined strains, and you then go out onto the field, you can transport it with you. There are cases where there's been tourists, Australian tourists, who have been in fields in Europe, got on a plane, got home and were excited to see their crops and went out and transported and infected, transporting it that way. Also transporting it, they know spores can be transported at high level between South Africa and some other countries. Also it's rare, but it can be done. For example, between New Zealand and Australia they know that stem rust spores can move at high levels but that's generally, that's the exception.

NP: When you come back into the country one of the few questions on the form is, "Have you visited a farm?" Are they, because of the increased alert about this problem, is that something that they look for or is it still mostly the animal farm contamination that they're worried about?

RD: It's all of that. You can transport organisms on your clothes, your soles of your shoes. It's not only the things about our farm, it's what happens in our ecosystem. Didymo, which is an algae thing that will grow in water--.

NP: Spelled?

RD: D-I-D-Y-M-O, I think.

NP: Okay.

RD: Well, there's been some canoeists who have visited Australia coming in from, let's say Canada, and their canoe was not clean, or their kayak was not adequately cleaned. They've moved didymo into New Zealand. Movement of microorganisms that are not present in another environment is a big issue, is a big concern, and I don't think people appreciate the need for biosecurity.

NP: Like the zebra mussel infestation of the Great Lakes.

RD: Yes, exactly. The Canadian Food Inspection Agency [CFIA] or others that have responsibility for biosecurity, it is real. It is important. And as citizens we should be informed and respect them. It's better to say, "Yes, I have been in another country. Yes, I've been in the forest, or I've been in the water, or I've been on a farm, and, yes, it's no big deal." Like when I go to New Zealand, I'd clean my shoes beforehand and all of my other stuff, but I declare, "Yes, I've got stuff. I'm an agricultural researcher, and I'm going to be going out," and they look at my gear and they say, "Yeah, it's clean," or not. "I think you should put some formaldehyde on," and I'll do it. It's no big deal. It's no big deal.

But when we go the other way, and we introduce something that is foreign, like the Zebra Mussel as you mentioned, you can go on and on and on, there's lots of examples. Our weeds that we have in North America are primarily introduced. Rust is introduced from Europe. Rust is not indigenous to North America. It's not. It's introduced. And the orange wheat blossom that I mentioned to you, that's an introduced insect pest. It was all done innocently. When the settlers bought their wheat seeds along, they also brought the carriers, the wheat seeds with them. The house sparrow is something that is introduced.

NP: Pigeon.

RD: Yeah.

NP: Or at least the one that lives and prospers. [Laughing] You have the rust, which is a happy little camper and manages to mutate, if that is a proper term, quite rapidly. What is it about wheat that its resistance doesn't mutate as quickly to deal with it?

RD: Well, it depends on the mutation rate of both the host and the pathogen. In the case of the rusts, you've got two ways of developing new variation. One is through sexual means, but that has to go through an alternate host, and in the case of stem rust, it is on the barberry. The other way is through mutation. The mutation rate is not that high but because you have so many spores being produced—millions, billions, trillions of spores—that even though it is a low mutation frequency, it still will occur, and because you've got that one resistant or that new mutation falling on the wheat crop that has a resistance gene, it will then be able to overcome it. I think what I should really do is go through this Canadian Triticologist

NP: Can I ask a few questions first?

RD: Yes.

NP: What are you most proud of having accomplished in the work you have done?

RD: I would say doing what was thought not to be possible. I'll give you some examples. When I was a student and when I was a young scientist, the common [belief was] that grain yield and protein content are negatively related, and if you want more yield, you have to give up protein. If you want more protein, you have to give up yield. You can't increase both simultaneously. Well, here at our research institution,with our team of scientists like Dr. Tom McKay, John Clarke, Ron Knox, and now the new scientist Richard Cuthbert, we have developed more photosynthetically efficient plants that have been able to produce more biomass and the biomass then gets partitioned into carbohydrates.

We were able to use a new technology called near-infrared spectroscopy. Dr. Phil Williams, a Canadian from the Grain Research Laboratory, was most instrumental in being able to develop this technology to measure protein content. Back in the early to mid 1980s, we were able to get an NIR instrument and do a calibration and the calibration set up this project with funding from the Saskatchewan Agricultural Development fund.

NP: And what is NIR?

RD: It's the near-infrared spectroscopy. So it's a way to use reflectance technology to measure to develop a calibration to the protein. It's a non-destructive method. That means you don't need to use any wet chemistry or grind samples and that kind of stuff. We were able to develop a calibration equation to be able to predict the protein content of the grain very rapidly. Before that, it had to be the Kjeldahl method, which was very slow, toxic chemicals, and as I said, slow. Whereas with the NIR, we were able to get our results within minutes.

What we were able to do then was harvest our experimental lines, measure the grain yield, the productivity traits, and then take those experimental lines that showed above-average performance traits as well as the disease control, only with those that had simultaneously acceptable yield and protein. Out of that work starting in about 1985, we were able to select simultaneously for grain yield and protein content and shift the negative relationship. We didn't break it. We shifted it which meant we were able to produce material with both higher grain yield, and there was no loss in protein content.

NP: Did you need a break?

RD: Nope.

NP: Okay.

RD: So out of that is an example of a variety called AC Barrie, which was released about 1993 or 1994, and it became the predominant wheat variety after only two years being on the certified-seed makers of cropland by 2007. It had higher quality resistance, high quality resistance to fusarium head blight, very high protein content, giving it desired baking contents. The cumulative incremental value due to increased grain yield was estimated at more than $544 million, the incremental value due to the higher grain protein $251 million, and the incremental value associated with approved standability and crop residue management efficiency was estimated at $38 million dollars. So that was to 2007. Cumulatively, I think we're looking at about $800 million incremental value. So that's one thing quite satisfied or pleased with. They said it couldn't be done.

Another one is they said that in order to have high protein content, you had to have tall stems, long straw. Well, we have developed a semi-dwarf with higher yield and higher protein content. I'd have to get you the exact numbers, but I think it's about 15 to 18 percent more yield. I think it's about 0.9 percent higher protein, big time more protein, simultaneously, and it's a semi-dwarf! They said this couldn't be done. We've done it, and it's out there on farmer fields, growing very successfully in Alberta.

Okay, another one. They said in order to resist fusarium you have to have tall material. The resistance gene is pleiotropic with height. It's pleiotropic, which means you can't separate them. The gene that is contributing to resistance is also contributing to taller statures. Well, we've released a semi-dwarf called Carberry which is a semi-dwarf, and it does have good fusarium resistance, good standability, resistance to all of the diseases, and is very widely grown in the disease area of Manitoba and elsewhere.

NP: Now in many of these cases you've talked about shorter crops. What is the advantage of shorter crops?

RD: For the producers now, the cropping system, which means that the crop residue is left on the soil. They do not till. They do not work any of the residue into the soil. So that all of the stuff about the plowing after harvest is no longer going on. They don't burn stubble. They don't burn residue as a way to manage it. Well, for that kind of a cropping system, if you've got something that's a metre to a metre-twenty tall, you've got a lot of biomass, a lot of long straw that your implements will not pass through. If you've got a semi-dwarf, then you've got less residue to manage. Your implements will pass through it.

The next thing is the grain is in the spike or the head, and that's at the end of the stalk of wheat. So when you think of a lever, if you've got your weight at the tall end and you've got a long stem, well, that weight, in the wind and the rain, it's going to topple over. Whereas if you've got a short stem, it's much easier to hold it up. Then when you go into the farming operation for harvesting, if your crop residue has laid on the ground, if your crop has laid on the ground, you now have to pick up at a very low, but you have to pick it up. You have to use crop lifters to get it up and you have to now put all of that biomass through your

combine. That is using a great deal of energy and energy is expensive. It's slow operations you might have to only, with your swather, only travel in one direction or you combine in one direction.

With something that is standing upright and can take that, you can only have to cut the upper part of the stalk where the head is, and you can leave the rest of the grain residue. So you are able to travel at a faster speed, harvesting more bushels per unit of time, with less energy. So that's the harvesting side of it. Then when it comes to the crop residue management of it, you have less energy required to manage that residue and you can use zero tillage.

NP: And how does all that research development contribute to Canada being a successful grain exporter?

RD: Because whatever we do by any one extra bushel, even one extra bushel, has to be transported, has to be sold, has to be processed, has to go through all of the logistics to manufacturing and so on. So that's just for one bushel. When we scale it up in acres, and producing over 20 million metric tonnes, each time you say that we will increase the productivity by one percent, that's how many extra metric tonnes per year? 200,000 metric tonnes of incremental grain. Yes, our rate of genetic gain in the case of wheat since the farmers have been investing in wheat—since the late '90s—we have doubled our rate of genetic gain. We are running at about 0.6 to 0.7 percent increase in yield per year. Increased productivity results in reduced producer input costs, greater profitability, greater competitiveness, and better water use efficiency, and still, at the same time, providing safe and nutritious food for consumers. So it's a big, big web, and we in research are only one little part of it, but it is an incredible tapestry that gets woven.

NP: Yes. Challenges. Not just exclusively challenges of a technical or scientific nature. What have been the major challenges that you have dealt with? I mean, it's obvious that just keeping ahead of these other critters that are--. [Laughs]

RD: The challenges? I have said this on more than one occasion. The governance structure of Agriculture and Agri-Food Canada is our greatest constraint to genetic progress. We have the knowledge. The biggest constraint and that has to do with the institutional rules. It's got to do with the way in which the bureaucracy that gets built, so that it becomes--. There isn't incremental value added through a lot of the bureaucratic process. I could give you examples of that.

NP: Well, give an example.

RD: Okay, I'll give an example. To do a partnership with a funding agency, whether it's the Saskatchewan Agricultural Development Fund or the funding agency in Alberta called ACIDF [Alberta Crop Industry Development Fund] or seed company, any of these, to do a partnership, the first step that you have to do is write up a research proposal that meets the requirements of

the funding agency. You have to, in that proposal, provide the deliverables, the milestones, and a budget to do the work, and of course, while that is going on, you have to ensure you work with your site manager and the science director, that they are okay with this project, if it was approved that we could go ahead and do it.

When the funding agency says, "Yes, we agree with this. We will fund this project," the next step then is to develop an agreement with the funding agency, which makes sense. You've got to have an agreement in place. So we say we will do this. They say they will pay for it, and they want these deliverables. Okay, that gets signed off and now the signing off level or an assistant deputy minister level or at the deputy minister level, depending on the size of the agreement. So this will now have been reviewed by all of the people within the institution. So, you'd think that once the agreement is signed, if you were efficient, then you would say delegate go and do according to the signed agreement. Well, our local site manager, our local science director, cannot implement it according to that signed agreement. If somebody that was hired to do the work in the meantime, they've been here for X-number of years and they've retired or resigned or whatever, they're no longer here, we thought they were going to be here, but they resigned, and you have to restaff. The local people have no authority to approve the staffing. It has to go up through a horizontal management group, way up there, and they will make a decision. So, it becomes completely disconnected from what was the signed agreement.

NP: Has it always been this--?

RD: No, no, it has evolved to this I would say since about 2003. It has gotten progressively worse. So, the biggest constraint to science within the federal government is the bureaucracy, and anybody that knows me, listen, I've been saying this because it's true. A director general doesn't even have the authority to approve the staffing on something he has agreed on a research project. I would say that's the biggest constraint. The regulatory process has been difficult, but not impossible. Not impossible.

NP: Are you talking about getting the things registered?

RD: Yeah, getting new varieties registered. It's a very clear process. If you've got something that meets the standards, you can get it registered. So I don't buy this thing about it's impossible, you know, that it's incomprehensible, you know, the wheat variety registration system. I don't buy it.

NP: Is it not under review?

RD: Yes, it is under review to see what we can do about modernizing and streamlining, but it's not an impossible situation. Our team here at Swift Current in the last, since 1973, we've registered about 51 varieties of wheat, durum, and triticale. So, it's not an

impossible situation. If you've got something that meets the standards, it's a cakewalk is what I say. If you don't have something that meets the standards, yes, you will be disappointed, but even if you've got it registered, you'd be disappointed when you got it into the marketplace because you'd have a lot of farmers upset with you for bringing forward something that wasn't as good as something they've already had.

NP: I do read the *Western Producer,* courtesy of the Canadian Grain Commission who has offered us some administrative services because they couldn't give us anything else, but that works very well. And the relaxing of the system, why is that a contentious issue, that registration issue? What are the dangers, what are the advantages, and, in your mind, where is the balance struck?

RD: There are some concerns around the variety registration system with regard to limiting or appearing to limit farmer choice. In Canada, the Canadian Food Inspection Agency registers spring wheat, durum wheat, and winter wheat. That's all. The Canadian Grain Commission, under the Canadian Grains Act, establishes the market classes and grades within. In the Canadian variety registration system, we have—in Western Canada—have opted, in fact we have deliberately chosen, to link the determination of the value for cultivation with market classification. We have deliberately decided to do that.

NP: Why?

RD: Why? I would encourage you to read the Garnet story. Have you read it? Okay. What happened? Garnet was registered through, at that time, Canada Department of Agriculture for growing, and the production, as delivered by the farmers, was then sold through a completely different group, and was managed--. It was the Canadian Board of Grain Commissioners or whatever it was. The Canadian Wheat Board [CWB] at that time was reporting to a whole other department, whether it was Foreign Affairs or Industry Trade and Commerce. Whatever it was, it was a whole other group. But Agriculture and Trade were in two separate groups, and the Canadian Grain Commission was completely separate camp from Agriculture. So, market classification and agriculture, two separate camps.

So, when the grain from Canada was being sold that had a significant proportion of Garnet in it, the end users were complaining. Then to deal with the customer complaints, the Canadian Grain Commission at that day had to sort out what is the appropriate market classification for Garnet. Because Garnet, at that time, they thought it was eligible. It was being sold as in the Manitoba was being eligible for all the Manitoba grades, the top Manitoba grades, which have since become the Canada Western red spring grades.

A big clash came then between the Ministry of Agriculture, led by Motherwell, and then this other group and, let's say, the industry side, the marketing side. The market clarification side said, "Garnet is not eligible for the top Manitoba grades." Well,

that was a huge disappointment to the Canadian farmers. It was out of that that we decided we should really be doing market classification when we are determining suitability for production.

Right now, Canada is one of the very few countries that determines eligibility for market class when they are determining value for cultivation, and that's a huge advantage to Canada. Why? Because at the time you register a variety, you know what market class it's eligible for. So, if you are a seed merchant, a seed company, you right away know what market class is this going to be eligible for. Then you can start to project what is the market size for it. So I can multiply seed and get it out to farms. I know what its value will be, and I can make a bid for it. Would I bid $10,000, would I bid $100,000, would I bid $300,000? Well, if you don't know the market size--. Again I'll use soft white spring as an example. Soft white spring is only less than 100,000 acres in some years, and hard red spring wheat, we're speaking maybe 20 million acres. So it's got a huge, huge, huge impact.

By knowing upfront, you increase the probability of knowing what is market class. That increases the value of that experimental line, as I mentioned, and it will increase the rate of adoption by the producers because when they plant it, when they buy the seed and plant it, they know that they're going to be able to take it to the elevator and declare what class it's eligible for. It will be on a market eligibility list that is determined by the Canadian Grain Commission

NP: Now, why--.

RD: Before--. In Europe, let's say in the UK, they register varieties by one group and then another group. Like the British and Irish Millers Association will determine what market category it fits into and the same thing in Australia. You'll get variety registration, and then afterwards it will determine what market class it's eligible for and that really slows down the rate of adoption of the materials. And also, you get a lot of disappointment.

NP: So why has the Canadian system not been adopted elsewhere?

RD: I would think that the emphasis on quality is the primary driver for us of that. In Europe it's only, let's say Germany or France or England, they've only got about four categories. Most, let's say for their top end of their bakery products, eleven bread products, only about ten percent goes into that market. Their big ones are feed. Confectionery is a small one, and then middle quality for the filler wheat is bigger also, but feed in England and Germany and France are very big, and medium quality wheats are big, and they'll be trading that--. Like France will be trading a lot of that into the Middle East as well.

In Australia, why haven't they done it? I don't know why they haven't done it, but it's a big bone of contention, and I was contacted by a consultant from Australia, and I think he was going to be putting it forward as an improvement on their system

because they end up with contentions. And in the United States, their wheats tend to grow by regions. On the eastern side--. Like let's say the U.S. grows more market classes than what we do in Canada, but they tend to be separated by geographical region. So in the eastern side of the US, they tend to be soft red winters. Whereas in the Pacific Northwest, they tend to be soft white winters, not red winters, but soft white winters. In the great central plains, they tend to be primarily hard red winters, and in Minnesota, North Dakota, Montana, South Dakota, that's where you'd have your hard red spring wheat, which would be similar to our hard red spring wheats. They're called DNS's or dark northern springs. Also, the durum wheats tend to be growing in that area of western North Dakota and Montana. So there's a big geographical thing.

So there isn't the same need for market classification while doing registration or variety release. But they do a lot of testing for quality also, a great deal of testing, and it's done afterwards, after the release. They will then source by particular region or county and so on, and in the US it's quite different. There's about 50 percent of their production is consumed domestically. Whereas we are maybe 35, 40 percent consumed domestically. There's a number of different drivers.

NP: So, if you go back to when this registration system was first developed, which would have been early 1990s, was it part of the Grain Act?

RD: No, the red variety registration is under the Canada Seeds Act administered by the Canadian Food Inspection Agency.

NP: When would that have been developed?

RD: The first one is about 1923 or something like that. I'd have to get you the history on it, but it's way back. Then the Canada Grain Act is what the Canadian Grain Commission functions under. That is a completely different act. The market classification and grades is done under the Canada Grain Act, but eligibility before something can be sold and brought into Canada, it has to be a registered variety and that's under the Seeds Act.

NP: Okay.

RD: Yeah, two very different acts.

NP: Now if you think of today's market, world, agricultural—what's the word I'm looking for?—philosophy, if we were--. **[*…audio skips*]** And they were in our position. So they had our system, we had theirs. Do you think our system could ever be developed here? And I guess the reason I'm asking this is that sort of throwing the baby out with the bathwater in trying to relax

the system. When I was asking about that balance, if you're trying to relax the system, where do you relax it to the extent that you lose the baby, in your mind?

RD: I think I'd like to discuss the word relax.

NP: Okay, good point.

RD: Do you mean that the standards are reduced?

NP: Well, if a system comes up for review, I think everything is up for review.

RD: Yeah. I think review is different from relax. Under the review of the variety registration system, and I think that's a good thing, and I think everything should be reviewed on a time-to-time basis. I think each year married couples should renegotiate their married vows. It should be reviewed and negotiated and so on. It shouldn't just be you get married and then that's it! I've been there. I've done that. I don't need to be concerned about the relationship, the quality of the interaction.

Everything, I think, should be reviewed. In the case of the variety registration system, I think—and I'm involved in a working group to review the Prairie recommending committee on wheat variety system and also been involved on the other side from Agriculture looking at registration systems for crops in other countries—I think there are things that we can do to modernize, use existing flexibilities that we have to establish the protocols for testing so that we have a scientific basis for the testing of whether it's agronomic trades or disease resistance trades or end-use ability trades, that the protocols are written out, labs are accredited, groups are accredited to generate the data, and then the data is vetted. And following sound statistical procedures you can determine if something has met the criteria or not. If something had met the criteria, three evaluation teams looking at if something is better, the agronomic, the disease team, and the quality team—if all three teams say this meets the requirements—then that candidate is automatically supported for registration. It doesn't need any further registrations.

But if one team opposes, doesn't support, then you would have, let's say, a way to evaluate, a cultivar valuation panel, where the candidate has to be presented before all three to determine if, on balance, what this group is saying is not acceptable, on balance—for the entire industry—it is suitable. Then that cultivar voting panel would give a recommendation for registration.

I think there are a lot of things that can be done to modernize and appear that would reduce--. The Australian system, I have had collaborations with colleagues from Australia over the years. They're not entirely happy with their system. I can give you lots of examples where they've been upset and agitated about it. The Australia brand, according to some of their buyers their purchasers,

feel that the Australian brand had been damaged by some of the changes that they have gone through. Whenever you're engaged in learning anything about branding, it seems like there is a value in a brand. So it becomes quite important that we take a bigger view to look at what is the value of the Canada brand as opposed that we have to think about what is the good of the nation as opposed to the good of the individual.

NP: I recall reading an article early on in the *Free Press*, the *Winnipeg Free Press*—and by early on I mean in the early 1900s—when the millers have come over to visit the chief grain inspector at that time. King was his name, I believe. Anyway, the millers were complaining that Canada was not paying attention to what they were sending over to them, and so that lead to the development, I guess, the classification system because that would have been under--. He was with the Board of the Grain Commissioners at the time. It went way back, and it was economically driven. But I wonder if the sense--. **[*…audio skips*]** And the reason I ask this I guess about people--. **[*…audio skips*]** Is a superior system in that you have an advantage in marketing. You avoid those disappointments and problems that you mentioned.

But in talking to other people in the grain industry on various topics, cooperation isn't what it used to be within the industry. So can you bring in a system that's based on cooperation and looking what's best for the nation these days? Or do you notice in your industry as well that the willingness to cooperate isn't what it used to be? Tell me it is. [Laughing]

RD: Okay, first of all, on the evolution of the market classes of the wheat in Canada and when it went into different market classes, this is a paper that co-authored with Brent McCallum, and so the evolution with the market classes is in Figure 3 here. It started off in the General Inspection Act of 1874. Manitoba grades came in the 1930s. Some of the different classes are in there. So that's another one.

NP: Thank you. We'll get a stack, yeah.

RD: I've got a whole stack here for you.

NP: Just to let you know we have about 15 minutes left.

RD: In terms of cooperation, in cooperation in research and development, I would say there is very good cooperation. There is more cooperation now than in the past that I would say my whole career has been around teams as opposed to individuals. That's been one of the strengths of us here at SPARC is that we've really had a very, very good--. And Agriculture and Agri-Food Canada has been very good partnering with the university, has been very good, and just recently has been the formation of what's called the Canadian Wheat Alliance, and that's a partnership of the National Research Council, Agriculture and Agri-Food

Canada, the University of Saskatchewan, and the Province of Saskatchewan. The National Research Council has decided to focus some of their basic science capability on wheat. So that's very good. They can bring their skillset on genomics and upstream technologies to apply to wheat crops. So that's a new thing. That's a brand-new initiative, and so that's a whole new partnership.

The partnering with industry groups, I would say, since we've been able to develop some tools with them since the 1980s, the latter part of 1980s, we have been able to have some partnerships with a company such as the SeCan Association. We've got a long-standing relationship with SeCan.

NP: SeCan standing for?

RD: Well, that's the name of the company. SeCan Association. It's just an abbreviation of Seeds Canada. But that would be an example and the producers have agreed to a voluntary levy on wheat and barely starting in about 1993 it was collected under the Canadian Wheat Board and administered by the Western Grains Research Foundation. They've put in about well over $3 million per year since 1995. So they're looking at about a $30 million investment in wheat. It's not quite there yet, but it's pretty close.

In each of the provinces right now, they're looking at setting up provincial commissions to administer checkoffs since the Canadian Wheat Board isn't there to collect the checkoff, or they're looking at alternative mechanisms and provincial commissions is one of them. So the Alberta Wheat Commission is up and running. It got started last August, and the Saskatchewan Wheat Commission is expected to get going in this year, and the Manitoba Wheat Commission are hoping that it will be up and running by 2014. I would say that the producer groups have been very, very supportive of agriculture research.

Yeah, and same thing with the international collaborations. I've got collaborations with the international organizations like CIMMYT [The International Maize and Wheat Improvement Center] headquartered in Mexico and ICARDA [International Center for Agricultural Research in the Dry Areas)]which was headquartered in Syria, but now they're in difficulty because of the strife in Syria.

[*…audio skips*]

NP: The changes in, you mentioned the Wheat Board not carrying in functions it did before, the Wheat Pools which I assume were pretty big supporters and promoters amongst their members disappearing, the introduction of major international companies into Canada—company into Canada at this point—will that make a difference in availability of funding and either positively or negatively?

RD: Yeah, if we look back Ug99, Manitoba Pool, Sask Pool, Alberta Pool, were the cooperatives. None of them directly invested in our programs. Sask Wheat Pool did start up a wheat breeding program, but Viterra--. Oh, Sask Wheat Pool did put in some before it went to Viterra. Yes. They were very instrumental for developing strong gluten durum. Very instrumental in strong gluten durum. We had a relationship with them for a few years, but our AFC side would not renew the agreements with Viterra. Viterra was interested, but we couldn't come to an agreement. But by that time, Viterra had gone public, so it was really no longer a co-op. So the co-ops, essentially, disappeared on their own. You know the history there.

NP: Yes. Every time something changed there, another terminal elevator was closed in Thunder Bay.

RD: [Laughs] Yeah, so there were lots of changes from the Prairie Pools. Glencore is now, when it comes to global movement of product, they're big! They're big. Australian farmers aren't particularly happy about Viterra, and now they're less happy about Glencore.

What we do know is that there will be product produced. Say we got an origin, and there will be people that we are a small population. We can't eat what we produce. There are people living globally, and they want food. So then we've got a supply, and there is a demand, and somehow the dots got to get connected. And that is the big issue of the whole grain trade, and I think it's a marvelous one. Connecting the dots.

NP: We are coming to our last few minutes. I'd like to ask a question of you, and you actually voluntarily answered some of it early on. We had a feasibility study done on our project to have an interpretive centre to go along with a national historical site being one of the terminal elevators. The consultant said that history very seldom sparks enough interest now. Spark, I think, is an interesting point, so they said you should really look at a science focus to your grain industry nexus in Thunder Bay. Would you be willing to carry on a further conversation at some point about what we can do to spark the interest of people and that as they come through and across Canada into how important this--?

RD: Sure, yes, yes, yes.

NP: And there isn't an experimental farm in Thunder Bay for--.

RD: And without all food and feed, fiber is through photosynthesis.

NP: Requiring some sun. [Laughs]

RD: Well, yes, yes. What is photosynthesis? I think if you could build something around along that, so you could get kids into understanding something about it. It's interactive.

NP: Well, I'd also like them to get interested in the genetics part, and you had said that, you know, that is what interested you and--.

RD: And there's things that you could do! And there's interactive displays that you could do!

NP: Well, see, and I know nothing about it, and I would hope that you would. I'm going to sign off now before we just sort of get axed at the end. [Laughs] So thank you very much for giving me this time. I really appreciate it. It was all I hoped it would be.

End of interview.