Interview with Linda Kull

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Interviewer: Mark DePue

DePue: Today is Tuesday, September eighth—September eighth? September 16, 2008. My name is Mark DePue. I am the Director of Oral History at the Abraham Lincoln Presidential Library. And I'm here with Linda Kull. This is part of a series of interviews we're doing with people at the National Soybean Research Center. Linda, welcome.

Kull: Thank you, Mark.

DePue: Why don't you start with telling us when and where you were born.

Kull: I was born in Illinois, have not left. Born in Mount Vernon, Illinois. And around fourth grade moved all the way up to central Illinois.

DePue: Now, maybe you don't want to tell us the birth date, but you do need to say that.

Kull: I was born in 1954. May 3, 1954.

DePue: Okay and a little bit about growing up then.

Kull: Well, growing up in a small town, I think, is wonderful. And it became to me wonderful as events like 9/11 happened. I felt very comfortable and safe living in central Illinois in a small town. Enjoyed small neighborhoods, being able to run outside and play. The school I went to was just a block down the alley, and that was always convenient.

DePue: What did your father do for a living?

Kull: My father was an architect. He designed churches and schools. He tried to stay away from homes. But I could drive around the country in central Illinois and recognize the schools and churches that his office designed. They had a similar, kind Frank Lloyd Wright look about them.

DePue: Something to have a labor of love. Especially doing churches, I would think.

Kull: Yes, he usually came home with a headache (laughter) working with committees and that. It's difficult. You know, when you send something out to a committee, you get a lot of different opinions. So school boards and church boards were always a challenge, yes.

DePue: Yeah, they're demanding folks, I would think. They have it in their own minds exactly how it should. What was your father's name?

Kull: Leland DeWight Gatewood.

DePue: Okay, high school. Did you start developing some interests? Did you know what you wanted to do with the rest of your life in high school?

Kull: You know, I probably didn't know what I wanted to do with the rest of my life, but as I look back, the interests that I had in high school were indicative of what I ended up as a profession. So in high school I loved science and math and the biological sciences, and I was secretary of the science club. Plants, oh my goodness. Enjoyed the study of plants. And that, along with my father being an organic gardener, kind of fed an area of interest that soon became my profession.

DePue: Did you have a big garden plot at home?

Kull: As big as the backyard would allow. Yes, Dad chucked that backyard full of vegetables. There were years that my sister and I found that we were out at the fairgrounds bagging up manure to bring home to the garden. When the community had a leaf drive in the seventies, Dad had hundreds of bags of leaves dumped in the driveway. And we mulched them up, re-bagged them, and put them on the garden.

DePue: So your chores growing up were a lot to do with that garden, I would think.

Kull: In the summertime they definitely centered around the garden. So in high school my sister and I had a wonderful exposure to freezing and canning. I learned how to use a pressure canner (laughter) without blowing up the kitchen.

DePue: Not every child, every kid takes to things like canning and working in the garden and collecting manure and things like that. But did you enjoy that?

Kull: I probably didn't enjoy the manure part. (laughter) But again, one of the wonderful things of a small town is you have this backyard and you can grow a vegetable garden and spend weekends of summers with the family doing simple things like canning and freezing. We were a very simple family. We didn't go out much, we didn't eat out much. Mom cooked three meals a day. So growing up with those types of events, it was a very simple life.

DePue: What did you want to do beyond high school?

Kull: When I graduated from high school, I wasn't sure what I wanted to do beyond high school. It was assumed that I would get married and have a family, and didn't realize that somewhere in my future was a PhD and the soybean industry. It just sort of happened.

DePue: Did you go directly to college from high school?

Kull: I did. I actually went to the local junior college and enjoyed that. But I was in the wrong area. I was in the area of business, so learning shorthand, and typing, and bookkeeping. And quickly found out that that's not what I wanted to do. So I was married, and had three children, and when the third child was in kindergarten, decided I wanted to go back to school. And I went back in the biological sciences and shortly found that I a passion, a deep passion, for the biological sciences.

DePue: What was your husband's profession?

Kull: He was schooled in landscape architecture, but his family had a rather large farm in central Illinois. And as his father wanted to retire, then he wanted one of his boys to get into farming. So we came back to the farm in 1976, bicentennial of our local community, and took over the farm and helped farm, which was about 1,000 acres.

DePue: That's a good size farm, especially in 1976.

Kull: Yes, it was. It was a nice size

DePue: Did you find it to be quite an adjustment from small town girl to farm girl now?

Kull: Oh, it was quite an adjustment. It was quite an adjustment. But what was wonderful about that is Grandma and Grandpa (laughter) were just down the road, a quarter of a mile down the road. And they had farmed all their lives. So my husband's family had been in farming all their lives, and she was a wonderful resource and help with trying to get me used to living on the farm.

DePue: What year did you go back to school?

Kull: Back to school in about 1985.

DePue: And I assume you still had some small kids back at the farm, then?

Kull: So, yes, moved to the farm in seventy-six and the first child was born in 1977. Second child born in 1980. And the third child born in 1982. Went back to school when my daughter, the third child, was in nursery school.

DePue: And that had to be quite a change, too.

Kull: It was. It was. But what we did was we had a little minivan and going to activities—ballgames, t-ball games, soccer games, dance lessons—just took the books with me. So we had a minivan and a stack of mom's books, and we traveled. (laughter)

DePue: And at the games, Mom's nose is in the books anytime there's a break?

Kull: Yes, they'd see me there. But I was probably studying (laughter) as we were watching the games.

DePue: What were you majoring on?

Kull: My major was in plant sciences. My first degree was in the botanical sciences, or botany degree, at Eastern Illinois University.

DePue: Okay. And after you got your undergraduate degree at Eastern, what year was that?

Kull: Okay, that was in eighty-eight, I believe. Nineteen eighty-eight.

DePue: And what did you want to do with this degree?

Kull: I graduated with a degree in botanical or biological sciences, and also certified to teach in the state of Illinois. So I had a teaching certificate for high school, nine through twelve. Student taught and decided that I might want to stay in school and work on a master's degree.

DePue: And did you do that?

Kull: Yes, I did.

DePue: At Eastern?

Kull: Yes. A master's degree in botany again, specializing in plant physiology. Finished that in two years and graduated in 1990. And stayed at Eastern and taught for four years, and enjoyed teaching. I was on the other side of the desk.

DePue: So you were commuting back and forth during the time you were teaching and obviously going to school?

Kull: Yes, but that wasn't a long commute. So that was about ten miles between university and home.

DePue: Did your children enjoy growing up on the farm?

Kull: Oh, yes, they enjoyed growing up on the farm. Farm kids get to do some things that the city kids don't get to do. We had three-wheelers and four-wheelers and lawnmower tractors that could just whirl around the house at speeds way too fast, way too fast. We had animals, enjoyed animals. Dogs and cats and an assortment of other critters outside. The kids would bring home snakes and stray cats. We got to shoot BB guns. They enjoyed that. You couldn't do that in town.

DePue: Well, that would have been a big attraction for me.

Kull: We also had chickens at Grandma's house just down the road. So they gathered chickens. There were hogs down there too. So they enjoyed some simple things, a very simple life on the farm.

DePue: You were teaching what course at the university?

Kull: At Eastern Illinois University I taught economic botany. That was a fun class to teach. Biology, and a microbiology class.

DePue: What happens next?

Kull: After four years of teaching at Eastern, I realized I really enjoyed the college atmosphere. And in order to stay in the college atmosphere, I needed a PhD. So I decided to, by encouragement from my family, because when you have three children and a husband, getting a PhD is a family effort. It takes their support. So I actually applied at the University of Illinois in two departments. And in one department, which was the plant pathology department, one of the USDA and faculty researchers received a grant from a soybean check-off board. And they needed a PhD student and a master’s student. And it was to work on one specific pathogen of soybean, that's *Sclerotinia* stemrot, still my favorite fungal disease of soybean. And that was a wonderful opportunity. It provided that PhD student and master’s student with a tuition waiver and a stipend.

DePue: Okay, there was a couple terms in there that maybe not all of us understand. Soybean pathogen.

Kull: So you want to know what a soybean pathogen is.

DePue: Well, that would be nice, yeah. I think I know, but just to make sure we establish that as a baseline.

Kull: (laughter) Okay. So soybeans and plants—but we’ll focus on soybeans—have pathogens just like people and animals. So soybean pathogens can be fungal or bacterial or viral or wormlike organisms called nematodes. So all of those are major soybean pathogens in Illinois.

DePue: And the other term was the check-off program. I’m not sure exactly how you phrased it, but the word check-off came up,

Kull: The check-off in the agricultural industry refers to farmer-funded programs. So check-off monies are accumulated by an act of Congress, provided for—I call it a tax on every bushel or unit, so in soybeans that would be bushel, that sold for the first time at the point of sale. And for soybeans the tax is one-half of 1 percent of the selling price goes into a check-off fund.

DePue: And the check-off fund is used for what, then?

Kull: The check-off fund can be used to promote and fund research for that particular commodity.

DePue: To fund institutions like this one, perhaps?

Kull: Not really institutions, but fund good research at these institutions.

DePue: The money is normally distributed through grants, then?

Kull: Yes, yes. So in Illinois, at the point of first sale, check-off monies are generated. And that goes to the Illinois Soybean Association, which is a check-off association. And then a portion of those monies go to the national check-off, which is United Soybean Board. And each one of those boards oversee the check-off funds and fund research, a lot of research, at universities.

DePue: Okay, and I think we're getting close, now, to when you actually came to this institution. So we've got you at the University of Illinois. You're a PhD candidate. Can you connect the dots to this institution?

Kull: To the National Soybean Research Laboratory.

DePue: Yes.

Kull: Okay. So I did my PhD work in a USDA laboratory that's downstairs, here, in the National Soybean Research Center. The USDA office or USDA lab is within this building and this building is called the National Soybean Research Center. The laboratory that I work in is the National Soybean Research Lab, and it's upstairs from the USDA lab, which is just below us.

DePue: So it was a natural progression. You'd completed your PhD and then did you apply for positions here?

Kull: So it took about six years to complete my PhD because during that six years, I also worked as a research specialist with a 100 percent appointment that would allow me to begin to work for the university, and be included in a benefits package, which is a desirable thing. And then finishing my PhD, I became aware that the National Soybean Research Laboratory was looking for someone to oversee their production research. And the production research was heavily funded by the Illinois Soybean check-off, also by federal and state sources.

DePue: Tell us what production research is.

Kull: With production research, try to grow soybeans with less disease and increase the yield. So production is how do we produce soybeans. How do you grow more of them with less disease?

DePue: Okay. Here's a big shift for us now, but I think you're ready for this one. Can you tell us a little bit—just a very thumbnail sketch—of history of soybeans in the United States. And I'm especially intrigued if you were to look 100 years ago, farmers in Illinois weren't growing soybeans. So how did we come to having it be such a dominant crop.

Kull: Well, if you'd want intense information, there's several books available that you could read. And I got my hands on one recently, expecting some questions about the history of soybean in the United States. And I became very intrigued. I could hardly put the book down. I didn't realize that so much had happened in Illinois that contributed to soybeans being a very important economic crop. So in the United States—I'll pull a few dates here. The first time that soybean is known to have been grown or planted in the United States was 1765. And that was in the British colony, not the United States at the time, but the British colony of Georgia. Then around the 1850s is when soybean was grown in the Midwest for the first time, first grown in Ohio, then Illinois, and Iowa. And then a few years later in San Francisco. And it was grown mainly for hay or forage for animals. And then as restorative properties for the soils.

DePue: So to put nitrogen back in the soil, for example. Did they really understand that aspect of it, back sixty, eighty years ago?

Kull: Not fully, not fully. That research was yet to be done, as why soybeans was able to restore certain components that are necessary for other crops in Illinois, like corn, to grow well.

DePue: Okay. When was the big explosion, when we suddenly saw a dramatic increase in soybean production in the United States?

Kull: There were several factors that contributed to the dramatic increase of soybeans in the United States. And that began, say, around the turn of the century, around 1900, when people began to conduct research on soybeans. The first research plot planted at the University of Illinois was in 1896. And they looked at the components of soybean that made it a good silage or a good animal feed. And they also looked at how soybeans could rotate well in crop systems. And also the first soybean variety trials were begun around the turn of the century at the University of Illinois. With research that was at the University of Illinois, with some personalities that pioneered soybean genetics and genomics and breeding and agronomics, and that was Professors Burlison, and Hackleman, and Woodworth with the research that they did. And then also the concurrent research that was going on by George Washington Carver at the Tuskegee Institute in Alabama in which he looked at the components of soybean—protein and oil—and created and developed over 300 uses for soybean. Looking at soybean as a viable crop for animal feed with the protein and oil composition, and the potential for products for human use, provided the underpinning for the expansion of—the explosion, actually, of soybean as a cash crop or an economically valuable crop.

DePue: So before the early years of the twentieth century, then, one of the problems with soybeans was nobody knew what to do with them other than cattle feed, perhaps?

Kull: I don't know if it was that. It was more or less we didn't know the value that was there.

DePue: And we're going to learn quite a bit more about the value and all the processing steps, and I'm sure that will be interesting. What are the base components, the value of soybeans, that we know of today.

Kull: Soybeans are known today for their protein and oil. A soybean seed is about—and it ranges because the environment will influence the oil composition and the protein composition. The soybeans are about 20 percent oil and about 37-38-40 percent protein.

DePue: Is there any other crop, food crop, that has that high level of protein in it that you know of?

Kull: I think soybeans are known for their protein composition.

DePue: Yeah, that seems to be a very high content. One of the words you mentioned: genomics. Am I pronouncing that right?

Kull: Genomics.

DePue: Genomics. Can you describe what that is?

Kull: Genomics is the study of the soybean genome and the study of the traits and what they do, either functionally or structurally, for the plant.

DePue: Okay, and let's go on to your specific area, the pathology side of it. What are the things that especially threaten soybeans?

Kull: Okay, so the things that, say, threaten soybean yield?

DePue: Yeah.

Kull: In Illinois and in all major soybean production states, there's probably around a dozen pathogens that are continually beating back the yield of soybean.

DePue: Are there some in particular? And you mentioned cyst nematode.

Kull: Soybean cyst nematode is the number one yield-reducing pathogen in Illinois and the world.

DePue: And what's the best way that we've found to combat that?

Kull: Typically, for any disease, the best way to combat or control the disease or manage the disease is with resistant varieties. So that would be a farmer's choice, is to plant resistant varieties that aren't affected by the disease.

DePue: Well, how much does this institution have to do with developing those resistant varieties?

Kull: It's a major focus. In fact, with most soybean research programs or production programs, there's two major focus areas. One would be looking at traits or genes that increase yield, identifying them, and moving them into the varieties that are preferred by growers. And then screening varieties for resistance and turning those varieties—we're a public institution—making those that germplasm or those varieties available for companies, so they can incorporate those traits within their germplasm or varieties that are preferred by soybean growers.

DePue: So genetic modifications is a very big part of that process and what you do then, as well?

Kull: Genetic modification would be a little bit different than conventional breeding.

DePue: Okay.

Kull: So with, say, germplasm and breeding efforts, that would be done by traditional breeding methods. That would mean you'd produce, say, a non-genetically modified germplasm or variety.

DePue:Germplasm meaning?

Kull: Germplasm would be a general term that refers to maybe a variety or a line or a population that's not a named, commercially available variety.

DePue: I guess the word that scares people, though, is genetic modification. That's developed a certain reputation and some people are concerned about that. Can you talk about what it is and then maybe a little bit about the ethics of it?

Kull: Genetic modification that would tend to concern people would be that process that brings genes or DNA from an organism outside of the soybean genome into the soybean genome. So bringing DNA or genes that are not within the soybean genome could be termed genetic modification.

DePue: Do you have any examples of that?

Kull: Yes, they're good examples though.

DePue: Okay.

Kull: So some of the technologies—and we think of technology in agriculture as that piece of equipment like GPS technology sitting on a tractor, but there's other technologies that are just as important. And one of those would be a genetically modified soybean, say, like the herbicide-resistant soybean. We know that as a round-up ready soybean or a liberty link soybean. So that's a soybean that has a trait or a gene that's not found in the soybean gene pool, that gives the soybean a trait that's economically desirable. For example, we can spray herbicides on soybeans, kill the weeds, and the soybeans still stand up.

DePue: What would you say to people that argue, well, that's just wrong. It's dangerous to introduce that to the food supply.

Kull: I would probably say we're all more than welcome to have our opinion about the food we eat and the crops we grow. But what we've found with genetically modified crops, and soybean in particular, is that those genes are really not harmful to us. And they're advantageous to the environment. That means we may be better stewards of the environment. We spray less of a chemical in the environment. They can lend themselves well and support soil conservation. So when you weight the positives and negatives, chances are with the genetically modified technologies that we see now, there's more advantages than disadvantages.

DePue: Soybean rust is another thing that we've heard about increasingly over the years. Can you talk about why that's something that's come to the public's attention here recently?

Kull: Well, until 2004, soybean rust did not occur in the United States. In the countries in which it did occur, it was a very devastating disease. Very devastating disease. So you can imagine for the ag industry, the soybean industry in the United States, to contemplate soybean rust arriving, it was a very awesome thing to think about it. And one of the main reasons that it was a fear is that there are no varieties that we were growing here, at that time, that had resistance to soybean rust. Plus, as a pathologist, you have an appreciation for what pathogens do and how they do it. There's some pathogens that move in slow and their life cycle is one that allows the disease to maybe develop slowly, whereas with soybean rust and other diseases of any economically important crop—there's rust for corn and rust for wheat—rust is a rapidly cycling disease. Which means it can go through a life cycle or through a cycling event and produce lots of effective—we'll call them propagils—called spores, that can infect millions of them. Can infect and re-infect and re-infect in a one- or two-week cycle. That's a scary disease.

DePue: Does it stay in the soil, then, after the crop has been harvested?

Kull: Rust doesn't over winter here. Rust is a pathogen that is an obligate, a pathogen that has to carry on its life cycle in living tissue. It's kind of like a virus. You know, a virus can't live out by itself—it needs a human cell to carry on and recycle itself or renew itself. So with rust, rust needs living, breathing tissue in order to continue to produce more rust spores. So in Illinois, in the winter when all the plants are dead or they're perennials and their living parts are still underground, the only place in the United States that rust can live through the winter would be in the southern tier states.

DePue: Which, traditionally, haven't been the major producing areas for soybeans in the first place?

Kull: Yes, that's true. That's true. So the major soybean production states are not the states in which this pathogen can over winter.

DePue: But it sounds like you've just described a scenario where it's a huge problem in Brazil.

Kull: Yes, it is. It is a huge problem in Brazil. When you think of the devastation of the pathogen, there's several things that you need to consider. Actually, three things. We'll call it the disease triangle. And it is a triangle. You have the host, and the pathogen, and the environment. And areas in which diseases like rust are very big problems—they're economically important problems—is an environment where you have the host and the pathogen—is an environment, is the point, where disease can occur, in which the host and the pathogen are always there. So in South America, the host and the pathogen are there. And it also has an environment, almost year-round, that can allow rust to continue to infect.

DePue: Now, you alluded to something when we first started this conversation that, at the time when the word came out that soybean rust was starting to migrate into this part of the country, there weren't varieties of soybeans that were resistant. Does that mean that there are soybean varieties now that are resistant?

Kull: We're working on that. And that's one of our efforts, and that's one of the efforts that the soybean check-off in most of the soybean production states would be contributing funding to universities to look for rust-resistant varieties.

DePue: Are you partnering with any other parts of the world in that process, since it's such a bigger problem in places like Brazil, and I would imagine in places in Asia, as well.

Kull: Yes, the University of Illinois and most universities, that's one of their major efforts, is partnering with groups internationally and exchanging students and exchanging information and exchanging soybean germplasm for us, with different countries.

DePue: Okay. Well we've covered a lot of terrain here. What have I missed so far that you needed to talk about, in terms of the work that you do here?

Kull: Oh, my goodness.

DePue: I know that the next step, we're going to see some things. Go ahead.

Kull: Well, since I'm a pathologist, one of the major ongoing challenges is to find resistance genes. And soybean has a very narrow genetic base, which means that all the hundreds of varieties that are grown by soybean producers in the United States come from only a few ancestral varieties. And that can be a problem. Because if you don't have resistance, say to soybean rust or soybean cyst nematode or any economically important pathogen, where do you go find those genes for resistance? Where do you go look for new or novel traits for yield or disease? So you ask somebody that and it's just, I don't know, where do you go look for novel genes. And there's places. For example, the home of soybean—where soybean originally grew—is China. And also in Australia, there's some exotic relatives of soybean. So for soybean, we have researchers and scientists that have gone back to China and the Asian countries. And they look for soybeans that are, say, close relatives or distant relatives to the *glycine max* soybean that we grow today. Or go to Australia and find distant relatives, exotic relatives. Say, the glycine *tomentella*. So that's a different species.

So in China we find *glycine soja* and in Australia we can find glycine *tomentella*. And *tomentella* in Australia is growing in ditches as a vine-y little weed. It's not a very impressive looking plant. We can bring these germplasm lines, these germplasms, back to the United States and begin to screen them for diseases. So these would be traits that we're looking for that aren't in the germplasm or soybean genome that we have access to today. If we identify soybean rust resistance, or high-yield traits, then in these plant introductions that we bring back to the United States, then the challenge is, how do we get them into our current or elite germplasm that's preferred by soybean growers here in the United States. And that can be a challenge. For *glycine soja* they cross very well. So a breeder or an agronomist can make those crosses, moving pollen from one to the flower to the other, and screen those generations or subsequent generations. For *glycine tomentella* that's a bit more of a challenge. And that makes sense because some of the most desirable traits that we found, new traits, we have found in *tomentella*. That would be resistance to certain diseases that we don't have notable resistance to right now.

DePue: What's the timeline, though, to introduce that into the variety of soybeans that's going to be commercially viable?

Kull: And that's a fantastic question. And we answer that question with farmers that we meet here in the lab quite frequently.

DePue: Yeah, that's an immediate concern of theirs, I suspect. (laughter)

Kull: Well, we get to sit down and talk to farmers on a regular basis here in the lab. And we ask them, What do you need? And they tell us, you know, in the area of weed control and disease control and yield, on agronomic practices and disease management practices, you know, what their challenges are. And what we're looking at is, from our point of view, there's short-term deliverables and there's long-term deliverables. In weed science, in some agronomic practices, we can start a research program, and in a year, have a deliverable that can go right to the farmer and it can be information that he can use or she can use to make decisions. And that's wonderful and that's easy to understand. But, to answer your question, there are also long-term deliverables. And usually, breeding for resistance, it starts in the public domain or at universities, breeding for high-yield traits. Those are long-term deliverables. So our investigators start with screening germplasm. The pathologist will screen a germplasm, They'll hand something off to the breeders. The breeders would necessarily start moving those traits and developing genetic markers for those traits, so that as those populations are screened for those specific traits, then we can use markers instead of growing it out in the field once a season, and then screening it.

Markers are a very quick genetic tool that can be used to screen populations very young, identify those traits, and then move that germplasm along the pipeline. So an example, identifying a trait in, say, a *glycine soja* or a *glycine tomentella,* and that's about as far away from our elite germplasm, genetically, that you can get. And then making the crosses and moving that through the pipeline. That process of moving the identified trait into a commercially available variety may be seven to ten years. So that's a long-term deliverable.

DePue: That means that farmers get rather impatient in this process, I would think.

Kull: We can get impatient about it too (laughter) when we're doing the research. And what that would mean, too, is that you have students. Students are wonderful working hands. And they come in with brilliant ideas. Students and post-docs and academic professionals do a tremendous amount of their research that's reported at a university. A PhD student may be here for six years, may work on several projects, but never see that particular deliverable make its way into a variety. So it is something that goes through, maybe, a couple of different generations of students sometimes, in getting to the farmer. So it's hard to be patient at both ends.

DePue: Well, we need to get to the portion where we get to actually walk around and see some of this in action. But I have a couple questions for you before we do that. And it strikes me, here you are the daughter of an architect and couldn't even begin to imagine that this is what you would be doing two or decades later. But now you're an architect designing the future soybean, so to speak. I wanted to know what you think is the most significant or transformative change that you've see in agriculture, and especially agricultural research, in these last couple decades.

Kull: Probably the most impactful change that's occurred in the soybean industry has been in the area of soybean genomics.

DePue: What we spent quite a bit of time talking about here.

Kull: Yes, yes. So understanding sequencing and having genetic information, sequence information about the traits that are in the soybean genome, has probably provided us with the most potential in future. Technologies like herbicide resistance. Understanding how and why a soybean yields the way it does, you know, what are those genes? What do they do? We're getting close to that. So I think the most impactful event has been the sequencing of the soybean genome.

DePue: Okay.

Kull: Because that information can be used by many, many people in the public and private industry groups.

DePue: Okay, last question here is a different kind of question. Your kids grew up on the farm. How do you see the family farm evolving in the future and what do you see for the future of the farm in Illinois?

Kull: I think smaller farms are slowly disappearing and the farms that are in existence are a little bit bigger. That would mean that there's fewer farmers, and still the same amount of farmland. So the technologies that are available to farmers now allow them to farm more acres more efficiently than previously.

DePue: Is that a good thing or do you have some nostalgia for the old-fashioned family farm?

Kull: I think if you're from the old-fashioned family farm, those new technologies can be a little heart breaking. But when you see your children excited about GPS systems (laughter) that it kind of cuts both ways. Because I think, again, my kids were raised on a farm, I wasn't raised on a farm. So we had a time there, I think, to see some old things in farms the way that a farmer who had lived his whole life grew up and came to understand, with the garden and the canning and smiling and having dirt grit in your teeth and that. And to see the new technologies would be a sad thing, but to see your children in the next generation so excited about new things on the horizon would offset the advances that a person might see as something.

DePue: You sound optimistic about the future of farming in Illinois, then.

Kull: Oh, yes. Oh, yes.

DePue: Well, let's take an opportunity now to cut the tape here. And we'll pick it up with you actually showing us some of the dynamic aspects that you've got in the laboratory and some of the other things going on here at the National Soybean Research Center.

Kull: Okay. I'd be happy to. Okay.

DePue: Thank you, Linda.

Kull: Thank you.

Interview with Linda Kull

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Interview #2: September 8, 2008
Interviewer: Mark DePue

DePue: Linda, we’re now at the Cloth lab. Am I pronouncing that right?

Kull: Yes, Cloth.

DePue: Okay. What is it that you do here?

Kull: Dr. Cloth works on several different aspects of soybeans. One of the technologies he uses is called micro ray technology. What that allows him to do is look at gene expression over time, or gene expression at a certain point or certain event that’s happening in a soybean. For example, if we want to know what genes are expressed, say what resistance genes might be expressed when a soybean is being attacked by a pathogen, micro ray technology let’s us identify those genes that are expressed which may be resistance genes that we want to know about when the pathogen is attacking the plant.

DePue: So the trick is to isolate those genes?

Kull: Yes. And that can be a tricky business, and micro ray technology let's us get at that business so we can begin to understand the genetics of resistance reactions.

DePue: Okay. Let's go ahead and get into the lab, then.

Kull: What you see is a lot of different equipment. It's hard to be able to explain what all of this different equipment does. So you can see that it kind of looks like...

DePue: It looks busy.

Kull: It looks busy. Yes, it looks very busy.

DePue: And there's nothing wrong with that.

Kull: No. No, no. Usually, during the day you have a lot of activity in here. They heard we were coming, so they thought maybe they'd take a break.

DePue: Well, we should say we're close to the end of the day. The people who work here, are they working as students, as part of the university, or are they employees of the lab? How does that work?

Kull: So in most labs, and in Steve's lab, what we're going to have as staff members would be students, masters students, PhD students, or post-docs, those individuals that have finished a PhD, and before they look into jobs available in the industry, they might do one or two post-doc positions. It gives them experience working on a certain research project, and maybe allows them to write one or two more publications before they're out looking for a job, and it helps them with their competitiveness on the job. And then also you have research specialists that can help in a lab. So we got students, masters, and PhD, post-docs and research specialists.

DePue: And what kinds of things will they be working on here?

Kull: This is a USDA soybean lab. So they're going to be working on soybeans. They might be working on gene expression for soybean development, gene expression for disease reaction. Or say when the soybean begins to produce a pod and we want to know what genes contribute to oil production or protein production. We might be looking at gene production during pod formation.

DePue: Anything else you'd like to show us here?

Kull: Yes. There's another project that's going on here at the University of Illinois. It's a very unique project. University of Illinois holds the patent for this particular process, and I might explain that a little bit before I show you some really interesting little soybean plants. A little earlier we were talking about where do you go find new genes for resistance? Where do you find them? And one of the sources has been a remotely related cousin of soybean, glycine tomentella. So there's an investigator, Dr. Rom Sing, that's worked his whole life on breeding or moving genes from tomentella into glycine max which is soybean. There's a little problem with biology, in that if you try to cross these two plants, then you cannot produce fertile offspring. So to borrow an animal analogy, it's like crossing a horse with a donkey and you have a mule, but a mule and a mule cannot breed. So when we cross glycine max with glycine tomentella, we get offspring that are evolutionary dead end. They cannot produce other offsprings or viable seed. The seed are sterile or the pods abort.

Well, if you have some very interesting traits in glycine tomentella from Australia and you want to move them into glycine max, Dr. Rom Sing has made that possible. He's overcome some biological barriers. In this process that he's patented, one of the processes or one of the roads, I guess, to that particular success is culturing plants in growth medium. And I'd like to show you some of these plants.

DePue: Sure.

Kull: Let's go over here. So what he has to do is a long process. It takes three to five years to accomplish. And during this rather long process, he produces soybean plants in culture that are very tiny. You can see here.

DePue: ___ (??).

Kull: So to get to this point—

DePue: Maybe a little bit lower there. I think we can get less glare that way. Okay.

Kull: To get to this point, what Dr. Sing has done is made crosses between tomantella and glycine max, and the pods want to abort and that's the end of the process. He rescues the embryos out of the pods that want to die. In a certain interval, there's a few days in which he can rescue the embryo. Puts it into culture, and produces, through tissue culture, small masses of cells and then he treats these cells with certain plant hormones and chemicals, which allows them then to produce leaves but no roots. And at this point, too, he has to modify the chromosome number so that the plants that will eventually be produced are fertile, because the problem is we've got the wrong chromosome number here. So he can modify the chromosome number with chemicals and then produce a soybean plant that still has the wrong chromosome number, but grow this up and then put it in another growth medium that has a rooting hormone, root the plants, grow them in the greenhouse, and then begin backcrossing them to the glycine max parent that was originally used. And with each backcross, the chromosome number adjusts and it'll eventually get from 118 chromosomes, which is what we have here, to the forty chromosomes that glycine max has. Along the way, he's dragging chromosomes from the tomantella genome into the glycine max genome. And any of those traits that are desirable traits, which may be resistance to soybean rust or soybean cyst nematode, or sclerotineous dimrod(??) or they may be yield genes. They may be drought resistant genes. And we don't know yet, so we're at a point where we're going to begin to screen the varieties or the germ plasm, actually, that's in the greenhouse for certain economically desirable traits.

DePue: This job takes both patience and persistence, doesn't it?

Kull: Oh, my goodness, it has. It's been a lifelong challenge for Rom(??). And it's great to know that at the end of his career, in working with this particular cross, that he's been able to patent the process, and we're now understanding what a treasure trove of traits that we may have in his life's work.

DePue: So this particular process is something that's unique to the University of Illinois?

Kull: Yes, it is. Yes, it is.

DePue: Wow.

Kull: Yes.

DePue: Well, it is something to be proud about, and have a lot of satisfaction about, as well. For him to be able to do this, and a lot of the work here, I would imagine you need to have access to a huge variety of soybean seeds. Do you have a seed bank here, as well?

Kull: Yes. Yes, we do. The United States Department of Agriculture Soybean Germ Plasm Collection is located here on the University of Illinois campus at the South Farms, and there are, at last count, about 21,000 plant introductions in that collection. It's a wonderful resource. We haven't screened all the varieties or all the PIs that are in that particular germ plasm collection, so that's one of the efforts that's ongoing, is to screen that germ plasm for economically important traits, and also increase that germ plasm, too. There are efforts between university scientists and folks in other countries in movement of germ plasm between the countries and information between the countries, too.

DePue: Does all of this make the University of Illinois, this institution, the leading lab in the world?

Kull: There are several leading labs in the world, and University of Illinois is definitely among them when it comes to soybean research.

DePue: The leading lab in the United States for soybean research?

Kull: I'd like to say that, yes. We'll claim that honor right now.

DePue: And there aren't people in Iowa or Indiana or other places that would disagree with you?

Kull: We all do good research, and we exchange information, and we have some wonderful projects with soybean laboratories in other states.

DePue: I think you're ready to be a diplomat. Thank you very much, Linda.

Kull: You're welcome.

DePue: Anything else here?

Kull: No. Thank you very much for the opportunity.

DePue: Okay.

(end of interview)