

2014 BORLAUG DIALOGUE

October 16, 2014 - 3:55 p.m.

Panel: *Dr. David Muth, Moderator*

Introduction:

All right. Well, I think we're going to dive right into the final panel of the day. And as you all heard, both secretaries mentioned, and other speakers over the past two days, the importance of updated and accurate information and data to our country and our world. And so we have a terrific set of speakers here who are going to explore just that – issues in precision agriculture and big data. And leading that discussion is David Muth, Senior Vice President of AgSolver, Incorporated.

PANEL:

PRECISION AGRICULTURE AND BIG DATA: THE NEXT FRONTIER

Panel Moderator:

Dr. David Muth

Senior Vice President, AgSolver, Inc.

Panel Members:

John May	President, Agricultural Solutions & Chief Information Officer, John Deere
Kerry J. Preete	Executive Vice President, Global Strategy, Monsanto
Dr. Claudia Garcia	Senior Director, Global Market Access, Elanco Animal Health
Dr. David Gebhardt	Director, Agronomic Data and Technology, WinField

David Muth

Thank you very much. Did we get the mic going? All right, here we go. So it is my absolute pleasure and honor to bring this session to interact with these folks. We've got an exceptional panel to close out the day, and I think we're going to have a very interesting conversation.

Our session is titled, "Precision Agriculture and Big Data: The Next Frontier." I've got to say, Secretary Vilsack fires me up every time I hear him, too, and he actually had a really interesting lead-in from my perspective, as he closed out talking about the next generation and what we can do. I'm an Iowa farm kid. I grew up a hundred miles north of here and became engaged in the agriculture operation in the '90s where this vision for precision ag started to have some real

content added. I think back then the vision maybe said we were going to be just sitting in our offices by now and not really actually still going into the field, but that's a different topic.

And I came through Iowa State, trained in engineering and saw a lot of the development as we went through there and have spent some years in the R&D side of precision agriculture around bioenergy systems, including some time in Washington, DC, around public data and understanding the importance of those resources and most recently have started a precision ag company just north of town here. So this conversation gets very exciting, and understand through that evolution that now is the time where we're really going to start to see some interesting changes come around.

So I really invite everybody to take a few minutes and read the full bios for our panel. It's really a very accomplished group. We'll just very quickly work through and give an introduction quick. So Mr. John May is the President for Agricultural Solutions and Chief Information Officer for John Deere. He's been with John Deere since 1997. He's got an impressive and I'm sure very challenging role of enterprise-wide leadership for information technology, the Intelligent Solutions Group, which is an organization within here that's doing important, very important things for companies like mine. And I'm sure we'll get into that just a little bit in John Deere water.

Dr. Claudia Garcia is a Senior Director for Global Market Access with Elanco Animal Health. She has over 20 years of experience working in animal health. And we've heard a lot about talent development. One of the really interesting roles that I saw in her bio that she's had is selecting and developing talent – and that is critical. I can say from experience that this industry really is going to be all about the people.

Mr. Kerry Preete, he's the Executive Vice President of Global Strategy for Monsanto. He's led Monsanto through over a billion dollars in acquisitions and strategic partnerships to develop new technologies and deliver new capabilities to farmers across the globe.

And Dr. David Gebhardt, he's the Director of Agronomic Data and Technology for WinField. He grew up on a farm in Southeastern Minnesota where his three brothers are still farming, I have to interject. Southeastern Minnesota and Northeastern Iowa are probably some of my favorite place – beautiful country, trout streams, fly fishing. If you can make it, do it. And Dr. Gebhardt also leads WinField's National Answer Plot research program.

So to introduce this discussion, what we really need to start with is getting to a unified or consistent definition of what precision ag is. Our definition in very simple terms is really the process, the whole process of changing the scale of decisions so that we can maximize productivity per unit of input. It requires high-resolution data, the big data piece of the discussion. It requires high-resolution control systems, and it requires decision-making tools.

We're about two decades in right now. We've seen a lot of work on building that data, building those control systems, and we're seeing a lot of activity right now around the improved decision-making tools, and I think we'll learn quite a bit about that from our panel today.

So our first topic is – we'll go through each member of the panel and get that perspective on what precision ag is and a little bit from their perspective on how and why farmers are engaging precision ag right now as we're seeing it emerge.

So we'll start with Dr. Gebhardt. He brings an interesting perspective with his dual roles as a technology developer and a farmer.

David Gebhardt

Thanks, David. So first of all, I do want to thank the World Food Prize Foundation for having me here. As a farm kid that ended up roaming the halls of Borlaug Hall on the University of Minnesota campus in St. Paul, picking up a couple of plant breeding degrees, this is truly a very special occasion for me to be here. And you're the best audience of all, because you're here at 4:30 talking about data, so thank you very much. I really appreciate that.

But wanting to start like this: Historically, I think David hit a couple of good points. I mean, precision farming has been defined by a lot of it as technology – GPS, yield mapping, soil sampling – putting a lot of those things into variable rate systems, looking at management zones. And from a farmer's perspective, I think the beginning of precision ag was focused on cost savings. More recently, things like remote sensing, or active sensing, crop modeling, weather prediction and simulation, which I'm sure Kerry will touch on. These things have all now been added into the precision ag toolbox.

So now once we have all of the management zones created, we have an understanding of the field, there's been a lot more focus more recently on in-season management. We talked, I heard many times today, the genetic potential, we need more genetic potential. In corn and soybeans in the United States in particular, we have incredible genetic potential, so we need to implement these tools.

So I guess the bottom line, whether you're a farmer or a technology guy, I really think the overall bottom-line definition of precision farming is the same – we want to increase farmer productivity and profitability, we want to produce more food for the world, but we also want to do it in a way that is going to leave the land either at a minimum the same or maybe even improve the land as it goes. I mean, in more corporate, from my corporate hat on, that's sustainability.

But from a farmer's perspective, you know, farmers really do care about the land, and I think they do want to implement technologies to produce more food and also take care of the land.

David Muth

Conservation is a word that's fitting very well with precision ag right now, and I think that they are inherently coupled. I mean, efficiency means that we're improving environmental performance also. Mr. May, your definition of precision ag?

John May

First of all, thanks for including John Deere in this panel discussion. It's great to be here and to participate and also to be here with such experts in the industry.

So the definition of precision ag is actually quite difficult, because... and the reason I say that is it has to do a lot with where the individual producer is from a technology adoption standpoint. So if you think of it as a continuum and you go on the far end or the early adoption phase, some of our customers around the world, precision agriculture may mean simply mechanization; it may mean going from hand planting crops to using a planter that allows them to control depth, control spacing and control density. So to that grower or producer, that's precision technology.

Of course, on the very, very far end of that perspective, there are growers that are using the most advanced guidance systems, varying rates at the individual row unit, whether they're planting or doing applications, streaming data between vehicles, streaming data in a real-time basis to Web-enabled devices so they can make better decisions. So it's a broad continuum. And just to put that in perspective, that continuum isn't country based. You can go into several countries and see that continuum existing. Let me give you an example.

Today we sell our most advanced guidance systems in 85 countries around the world. This year alone, we've started selling guidance, advanced guidance, so this is the latest technology, in ten new countries in Africa. So that continuum exists across the world. But regardless of where you are on that continuum of precision agriculture, the benefit to the grower is, you're going to become more productive and you're going to be more profitable – and that's critical. And for those of you that have read the recent gap report that came out, we still have a lot of work to do on productivity around the world if we're going to feed this growing population.

So from our perspective, from John Deere's perspective, we believe precision agriculture is going to be critical to increasing that productivity.

David Muth

Thank you. Dr. Garcia, your perspective.

Claudia Garcia

Thank you for staying here and to listen to us. I'm from Mexico. I have an accent. So I'll be the second Mexican in the panel that you are going to hear from. For us, the nine billion that we have to feed in Elanco are reflected in the three billion people that are in emerging classes, those individuals in China and Mexico and Brazil and India that will access for the first time animal protein in the form eggs, milk, poultry products or meat. Those three billion have to be fed and it has to be produced in an efficient manner.

So our definition is connected to information technology and information technology that allows a small farmer or a really big farmer to use the data to be able to understand how to use everything in terms of inputs from water, pesticides, medicines, antimicrobials, vaccines in a specific population, in a group of animals or in a specific animal at the right time at the right location. Why is that important? It's because we are moving forward into an area where we no

longer go and look at the population as one single block of animals, but rather we're looking at a more specific therapy approach with the support of a veterinarian or someone that can allow for that supervision and be more specific at what we do when we treat or take care of an animal. It's very important, because it will allow them to be more productive. It will allow them to use less resources, and, most importantly, it helps animal wellbeing ensuring that animals are treated correctly.

David Muth

That's really important. I think precision ag typically triggers thoughts of global positioning systems and maps. And when we look at our system as a whole, the animal production side is very consumptive and requires a lot of inputs. And so thinking about and broadening that context is important. Mr. Preete, could we get your perspective?

Kerry Preete

Thanks, David, and it's good to be here. And I don't have a lot to add. I think that my colleagues did a great job of explaining it. Our simple way of thinking about it at Monsanto is it's the way that growers can harness the variability that exists from a crop production in their fields, the variability that is driven by the single-most challenging thing the farmer controls around the world, and that's weather. And it's the convergence, and what's really happened is the convergence of information technology and big data analytics with the incredible innovation that John's company is coming up with to execute a lot of those decisions, and then biology and really understanding the biology of genetics of the soil and bringing that together.

You know, your question on the farmer—I think any of us that have farmed understand the inherent variability that exists not only year on year but day on day, depending on the weather, depending on the variation within a field. And growers forever have been trying to harness that, whether they're farming 50,000 hectares in the cerrados or farming one or two hectares of cotton or corn in India. They're trying to harness that, and they see and understand it. And farmers that we've talked to around the world want solutions for it.

David Muth

So that was a great lead-in to our next topic, which we want to direct to Mr. May. As representing the OEM, the equipment manufacturer's side, often we understand precision ag as implemented on equipment for data gathering and the control systems that can implement our decisions. So how is your company supporting the advancement of precision ag, and what are some of the tools that you're providing for farmers?

John May

Absolutely. Thanks for the question. You know, regardless of where we are with growers in the production, where I said on that adoption, technology adoption curve, if they're early in the adoption of technology, or if they're a very advanced customer, we're investing in trying to deliver a complete and world-class solution for the customers. And the reason I say it that way is, it's going to take multiple pieces to do that.

Number one, it's going to take equipment. We're investing and continue to invest in developing highly productive equipment that meets the specific requirements of our customers where they're farming in the world. So equipment is the first piece.

The second piece of it is the technology, the technology that you mentioned. And we're investing really in three areas. The first area of investment is all around optimizing the machines. So when our customers purchase a machine, we want to ensure, by utilizing technology, we can guarantee that they're getting the most out of that individual piece of equipment. How we do that? From a remote location we can diagnose the performance of the position from a remote location. We can go on board and make suggestions of changes to settings, or we can just do that for the customer.

The second area within the technology segment of our investment is around job optimization. We believe there's a tremendous opportunity to do exactly what Kerry was suggesting, is, when our customers are completing jobs, we believe we can use technology to make them more efficient and more productive at that individual step in the production system. So, for example, if you're planting, utilizing technology, we can adjust the flow or density of seed at the individual row unit. We can do that across the entire production cycle. So how do we help them optimize the job, give them the information they need to do it, or simply do it for them?

The third area is in agronomic decision support. We're investing heavily in sensing capabilities that allows us to collect a tremendous amount of information, grower information, that allows them to make better decisions themselves or to share that data with their trusted advisors and have their advisors help them make better decisions. So within the technology, it's all about optimizing the machine, optimizing the job, and providing agronomic decision support, so optimizing that side of it.

And the third piece of it that you can't forget that's absolutely critical is we're investing in our dealer channel. Because, after all, it's going to take an individual dealer, regardless of where we are in the world, to serve that customer, to make sure that that customer is up and running and having that conversation with that customer around what specifically do they need to advance their operations in order to be more productive and more profitable?

David Muth

Thanks. I think everybody here can agree, and certainly a lot of folks in the audience, that the strides that are being made on getting information seamlessly to and from equipment are really valuable for all of our businesses and everything we're trying to do. Thank you.

So our next topic, Dr. Garcia, we want to dive in just a little bit further on the livestock industry. So with your background and expertise, could you give us maybe a little more perspective on precision ag in the livestock industry with animal health and productivity as a focus?

Claudia Garcia

Sure. I want to do that by using two or three examples that are simple and can give you an idea on different production systems, and farmers are small in scope or quite big. The intention is always to look for a triangle of metrics that we are looking for.

One is behavior, so understanding how the animal is behaving and what are they doing when they are healthy or when they are sick and being able to identify when that behavior is changing, suggesting whether they are under stress or they are getting sick.

The second will be health, ensuring that those animals are healthy and remain healthy during the entire process and that they don't enter the food chain sick or not being medicated or treated if needed.

And the third one is in terms of performance – be sure that those animals can reach the performance that they are genetically geared into.

And those three elements in that triangle have to be all in balance. So three very simple examples: One in Mexico with a program that we are running with Nestle, a program that we call GEM, Green Environmentally Friendly Milk Production or Milk Management. And we have farmers, small farmers in Mexico in Veracruz in the east side of the country in which we are helping them by monitoring data to help them allocate the cows in specific groups so they can feed them differently and they can treat them differently so they can increase production. That's a very small farm approach, and they can increase their production by 50%, 52% by just allocating, measuring and allocating those animals together.

If we go to farms that are quite bigger or much more specialized with more animals, we have a program that is called Vital 90 that is looking also in dairy. Those 90 days to go around the calving period are critical for the cow. If you successfully can monitor in a predictive risk assessment tool that farmers use with their phones or a tablet and they go and check different parameters, then they can assure that those 90 days for the cow will be correctly managed and they will produce to the level that they need as they are expecting in their production systems.

And the third one is one that covers Africa in a partnership with Bill and Melinda Gates Foundation and Heifer International. We are trying to help families in Tanzania, in an area around Tanzania, to get dairy cows and start dairy production by just teaching them very simple things of what kind of water they need, water filtration, feeding, how do you feed them, where do you put the feeder, etc., very simple steps in terms of technology that can help them initiate dairy production. So three different scenarios that can help produce in different areas of the world.

David Muth

That is exciting and certainly very important. It hints around consumption in some of the issues that we have in agriculture. We've talked a little bit about conservation. Often precision agriculture is thinking a lot more about increasing productivity and maximizing output, but the minimizing input story is one that's very, very important. So I'd like to go through each of the panelists to maybe quickly get to examples or statements about how your companies and the industry that you're working in is seeing some of those examples around improved environmental performance. Mr. Preete, could we start with you?

Kerry Preete

As we think about precision ag again from a farmer's perspective, we would say that in at least the major row crops around the world – and again this goes whether small farmer or large farmer – there's anywhere between 40 and 50 decisions that a farmer makes every year in every field. A lot of those decisions involve application of inputs – fertilizer, water, crop protection, products, seed. And we think through the harnessing of and understanding the variability that weather has on each of those decisions, literally on a daily basis or on a longer-term basis, we can start to optimize the inputs across the field and actually vary those based on current or expected weather patterns and start to draw some probability curves.

So, as we think, and Dave said this, we fundamentally believe that, with the technology that exists today, the genetics that exist, the crop protection products, the fertility products, we can see across most of the acres on the planet a 30% increase. So you start to think about that and the ability to freeze a footprint of agriculture, which we've talked a lot about here today at the various conferences, that is the impact that, from our standpoint, precision ag can have.

David Muth

That's excellent. Dr. Gebhardt, can you talk a little bit about that?

David Gebhardt

Well, Kerry took my answer, but that's okay. What I would add to that is the tools that these gentlemen are bringing to the market, in order to really implement them and realize that optimization of inputs... We've got this saying around WinField that agronomy is local – right? – so there are awesome, modeling, weather simulation, all these tools that need to be drilled down to literally a field level or within a field level. So some of the tools that we work with are hands-on tools, measuring tools. We do tissue testing, we do soil sampling, we do use other types of sensing tools. And those things together really optimize all these different opportunities to again – don't put your inputs where the crop can't consume it.

But on the other hand, there is a productivity message here as well – let's make sure the best parts of the field are getting what they need. So I think that's just the add that I would have to what Kerry said.

David Muth

You bet. Mr. May, any additions from an equipment manufacturing perspective?

John May

I think the two answers really talk about utilizing data that's coming off of the farm to make better decisions, and I think you said it very well – put the inputs where they're actually needed.

But from a technology standpoint, from an equipment standpoint, one of the technologies that we've invested heavily in, in the last 20 years is guidance. And when people think of guidance, they think of it as the farmer sitting in the tractor or combine, pulling a planter or harvesting a

field without their hands on the wheel and maybe reading a magazine and relaxing. That certainly is a big benefit, no doubt, for those of you that have combined a field or planted a field. But the biggest benefit is knowing the position of that vehicle. And once you know the position of the vehicle, we have the capability of executing their expertise in the field, varying the rate to address a microclimate within the field and maybe change the density of the seed on the planter based on what we're sensing in the field at that time, or adjust the application equipment, make sure that we're not overspraying or underspraying, controlling overlap, making sure that we're not overlapping rows. The benefit of that is not just on the input side, reducing inputs, reducing the application side; that is a tremendous environmental impact, but it's also compaction. It's the number of times you have to run over that field. You can reduce that, you can reduce the amount of tillage you need to do, and reduce the overall footprint on the field. So we're investing heavily, again, around the job optimization side to make sure we can take their expertise and insight that they have and execute it in the field.

David Muth

Dr. Garcia, do you have any additional thoughts on natural resource impacts from the animal perspective?

Claudia Garcia

First I want to say that you can actually also read a magazine while your cows are walking on their own, and there's a robot that can measure them, and they go to milk by themselves, and the machine can read whether they're ready, and washes them and checks them and sends everything to the manager or the veterinarian if they are sick and if the milk is not adequate, it will get discarded. So that is available too.

But I want to be sure that we are all clear to the fact that, when we talk about becoming more productive or more efficient, we're not talking about gallons and gallons more of milk are needed. If we were to produce 4.75 ounces more per cow, which is a glass like this one, more of milk, we could secure the needs of milk and calcium for the entire population in 2050. So we're not talking about a tremendous amount of milk. And it can be a cow in Mexico, in Africa or in the U.S. So the average production of a cow globally is two gallons, and we're just talking about 4.75 more.

All of us know very well that in animal production water use and feed use is significant, and it has to be reduced. So the more efficient we are, the less water is used, the less land is used too; and that will have benefits of saving not only water in an unbelievable amount but also in terms of waste. You have more animals because you are not efficient; and if you are trying to produce more, you will have more waste to deal with, more water consumed and more feed. And we really want to be sure that we optimize the genetic potential of the animals regardless of where they are.

We can save water – and I have here one number – if we could save 66 million cows by 2050, we will have 388 million fewer acres of land, so the size of Alaska, that we will not have to use to have animals, or 618 billion gallons less of water, enough to source of water 11 cities, the most important cities in the U.S. That's how important it is and why we believe that animals have to be more efficient and more productive.

Dave Muth

Those are some amazing stats. I've got to put that in my back pocket and try and figure out how to use that some more. So, Mr. Preete, you talked a little bit about weather volatility and how that impacts us. We know your organization has been active in this arena. Can you talk a little bit more about how precision agriculture and big data in general can help us be predictive and then adaptive to some of those volatility issues that we heard about previously?

Kerry Preete

I'll start with, even as we think about it as a plant breeding company, we've been using data and big data capabilities to develop some hybrids, corn hybrids and other crops that can perform better in changing climate, drier conditions. We've now extended that and started to think about harnessing the inherent variability that exists over a year or literally on a daily basis. And the capability the Climate Corporation gave us was the ability to measure weather and the environment on a hyper-local basis down to a field level, the ability to model weather and understand the longer-term probabilities of certain weather events happening.

And then the final piece is taking and using data analytics and science to start to model the impact of agronomic decisions. It's back to those, David, 40 to 50 decisions and starting to understand what an overnight rainfall or a certain level of humidity or temperature will have on the probability, for example, of a disease to occur in the next three to five days.

And that's how we think that, as Dave said, there's a lot of genetic potential there. The key is to protect it and unlock it, and that's how we are starting to think about using big data and the modeling capable that the Climate Corporation is providing us to start unlocking some of those answers to how to apply products. And John's equipment that he's developing gives us, the farmer the ability now to execute some of those decisions that John calls job optimization in the field. And that's how really the convergence of biology, equipment and information and big data come together.

David Muth

You bet. We're certainly seeing an impact when we talk and interact with farmers with some of what that weather data and what that capability is putting out on the market.

Our next topic moves into farmer adoption and then enabling policy, and we'll sort of move quickly, given our time constraints, through this. But the question that we want to work through is – what systems need to be in place to increase adoption in the use of precision farming practices? And are there some clear policy ideas and concepts that can help enable that? Dr. Garcia, would you start?

Claudia Garcia

For us, it's is very important, and Secretary Vilsack said it, is to have regulatory systems that look at the information and the science and interpret the science and the data in the same way. And if more countries can use those same standards across the globe and the same science, then I think we can all advance at the same time, versus having different regulatory systems or

approvals. And interpretation of the data, that's very important; it's critical. We can develop different subsets of approaches and interpretation, even though it's important to understand that the food basket in every country is different. But the more we can set up the policies and the regulatory systems to do it in a more concise manner, I think we can all advance much more.

The other piece that is very important for us is how we capture and manage the data, all of the policies that we put around privacy but also how we keep and maintain the data of big integrators or a farmer that has five cows, it doesn't matter, so that data is managed correctly. Those two areas are very important for us.

David Muth

You bet. One of the things we've realized is that farmers have become very accustomed to information being provided, attached to the other products they're buying, whether that be equipment, whether that be services, whether that be other kinds of inputs. Dr. Gebhardt, how do you view adoption and what needs to happen to accelerate it?

David Gebhardt

Yeah, farmers are kind of a funny bunch. We've got this saying around WinField, and I see it at home, is – It just happens. That's really the way that this whole data thing has to work. And again we're getting systems in place. A system needs to come off a machine, it needs to go into a cloud that an agronomist can access. The agronomist needs to bring that into his tools in order to do the agronomic analysis and recommendations and then send it back to the farmer so that they can execute it. And by the way, the farmer doesn't want to even know this stuff is going on. He wants to take his iPad or whatever, his device of choice, and take it into the combine, take it into the tractor and the planter, and all this stuff just happens. So that sounds really easy, but it is very difficult.

So one of the things I think we'll probably come back around to as far as policies or principles is around data and the data movement. And right now, I mean, everybody has a cloud-based solution for data, and I think that's an opportunity and a challenge. But the opportunity is that the companies are working together. Open Ag Data Alliance is one of the initiatives, I'm sure we're all aware of on this stage, which really talks about the ownership of the data and how it moves somewhat effortlessly from place to place.

My analogy is the financial systems. Agriculture has been pretty good to me the last couple of years. I've actually gotten a bonus check every year – it goes into my checking account. I don't want to keep it there; I want to put it into my financial services account. So I go into that side, I log in, I go transfer the money, and within 24 hours I get a confirmation that very securely my money has gone from one place to another. How does that really happen? So there are ways of getting that done from the technology perspective. One thing about farmers – they may be concerned about their data, but they're much more concerned about their money. So if we can show that it works in the financial world, I think we can get them over the hurdle with their data.

David Muth

You bet. We always throw that in there that if you provide value, then getting access to the information tends to not be a problem. We also refer to it as “the auto-steer dynamic.” And maybe we need to blame the equipment manufacturers, that they showed up with auto-steer, and it was so easy that everything else now has to meet that same standard. Do you want to talk about adoption a little bit, Mr. May?

John May

Sure. Just in general adoption of technology? Yeah. I think if you can demonstrate value, like you said, in the technology from the customer’s perspective, technology will adopt very fast. But I can tell you, some of the lessons we’ve learned over the years is it’s not about selling the technology itself, and I’ll give you an example.

One of the technologies right now that’s enabling all of this big data, that is, the data that’s being collected as you’re going through the field through the entire production cycle. So you start off and you’re preparing the fields, you’re planting the fields, you’re caring for the fields, you’re caring for the fields, you’re harvesting for the field – if you take all of that data, it creates a tremendous dataset that allows customers to do better planning, or growers to do better planning.

Telematics is really what enables that – it’s a form of communication to take data that’s locked on board on a vehicle and send it off board to a place where you can actually use it. When we first got into the telematics space, we tried to sell telematics without a suite of products behind it. And I can tell you, from an adoption standpoint, you’ve got to demonstrate the value for the customer around the specific job that they’re doing. And if you can demonstrate that value, like auto-steer, where you take the fatigue out of it, the adoption happens quickly.

David Muth

Mr. Preete, your organization is rolling out a lot of exciting technologies also. What do you guys see in terms of systems that need to be in place to get that adoption curve up?

Kerry Preete

And I won’t repeat what John and Dave said. I think the thing that we’ve seen is... Because a lot of these decisions are going to be made and impacted on what happened yesterday. And so the ability to have infrastructure that can move data quickly in some of the areas today is still a bit of a challenge. It’s built out a lot in the last few years, but to be able to get that answer quickly and move data, as John said, it’s got to get there quickly and seamlessly and then standards that could be in place so different companies and organizations can use the data, depending on where the farmer wants that data to go, so they can mine it and come back to the producer with insights. I think that’s going to be one of the keys to continue to see the adoption.

David Muth

So the final topic we'll cover, it actually falls right off, is data privacy and ownership, and it's certainly a really significant issue that we're all facing. We've talked a little bit about if we can provide value, we tend to be able to get access and share the information as it moves through. We talked about some of the alliances that are coming through. What are you seeing as the concerns that farmers and users of data are having, and how can we address those concerns? Dr. Gebhardt, if we could start with you.

David Gebhardt

This is a great question. So one of the things... At Land O'Lakes we are a cooperative system, right? So the farmers we represent, several hundred thousand farmers, they're not only our customers but they're our owners. So we sort of have an extraordinary responsibility for their wellbeing. Okay? You don't want to go make your customers angry; you sure don't want to make the people that own you have any issues with what you're doing. So we think a lot about their wellbeing and a lot about their data and what they own.

So one of the things we're looking at in order to kind of get our arms around this whole issue of data privacy and data ownership—first and foremost, I think we all pretty much agree here that the data is the farmers', and they need to have control of that. But again farmers are very suspicious. They're very suspicious of organizations taking their data and going off and doing something that will come back and negatively affect them.

So one of the things that we're looking at is, as a cooperative system, we are in the process of building a completely OADA-compliant cloud-based system that they could participate and have their data in. And if we would happen to come up with some way to monetize that through other opportunities, they would actually participate in that, just like they participate in the value of all the other products that they buy through us. So that's one way of kind of maybe alleviating some of the concern around data privacy and ownership. If there's value there and somebody creates it, in our system they would share in that value based on their level of participation. That's a model that they work on every day. So that's one thing that we're considering.

David Muth

Mr. May, what are you seeing as the concerns, and how are you dealing with them?

John May

It's a lot of what's been said. It's certainly two areas—it's the ownership and it's the security. And our focus is to live by our data principles, and really our data principles are structured around three main areas.

Number one is, we want to provide data to the grower that actually is valuable, just like we talked about, that they can do something with it. That means it has to be very easy to use and it has to be very accessible at the point where they want to use it.

The next is transparency—to exactly your point. The customer wants to know where that data is being collected and where it's going. That's a key pillar in our data principle. And the last is

control, and it's probably the most important from the grower's perspective. We give the control to the grower, and we let the grower make the decision where they want to share that data. And to do that, we've tried to develop a very open platform where we've already connected over 120 companies, and these are business advisors. They're agronomists, they're the leading application seed-type companies. And by connecting those companies, those trusted advisors, to our customers, that allows a vehicle for them to make the decision if they want to share that data with those trusted advisors, allow them to add value to it and then transfer it back.

So again it's value, it's being very transparent, and it's being very, very clear on the ownership side.

David Muth

Mr. Preete, do you have any closing thoughts on data privacy?

Kerry Preete

I won't repeat. We are at the same place as what was mentioned here in terms of the grower owns the data, they get to determine how the data is being used, and they absolutely have to be convinced, and they should be absolutely confident that world-class data security measures are being taken to protect it.

I think the other thing—and this gets back to the speed issue—the ability to move data quickly and move it seamlessly to wherever they want it to go so it can be looked at and mined and answers coming back to them that help their operation. I think that's the other thing that growers are really looking for, that it doesn't have to go through a bunch of reformatting and other things, because that means time and it may mean lack of ability for companies or organizations or their agronomists, wherever they want it to go, it can get there quickly and get interpreted so it can get back to their farm.

David Muth

Yeah, back to the auto-steer dynamic. So I do think we have time for one or two fairly quick questions for the panelists.

Question and Answer Session

Question Yeah, Patrick Bins from Seattle, Washington. Very interesting hearing about all the impressive modern technology and systems that you're bringing to the market. It appears that the immediate applications of these new applications are going to be for large-scale, modern farming systems. We hear often at these conferences that at the far, far end the subsistence and above-subsistence level farmers looking at bottle caps and microdosing as their version of precision ag. I'd be interested in knowing your thoughts or some suggestions on where things are going with precision ag technology in terms of handheld devices, soil-testing

kits, not smartphone but some kind of mobile device decision support system services that would be appropriate for the smallholder farmer who has maybe 50 hectares or a community knowledge worker who is working to assist an entire community with best practices. I'd be interested if you could share some ideas about that.

Muth Any panelist want to tackle that one first.

Preete I'll take a shot at that. You know, it's a very important point as we think about where the increased productivity has to come from. It has to come from a lot of smallholders around the world in addition to in some of the developed areas. We see that happening already. We've had a program now in India for several years where, John kind of mentioned it at the start, is where a lot of producers in India have cell phones, not quite yet to the smartphones; some of them have. We have been interfacing with those producers directly over the cell phone, giving them precision ag information, if you will, insight based on moth flights in cotton, based on what's happened with the local weather and anything they could be doing to improve their agronomist. So it's happening already. I don't think we're too far away from at some point getting maybe smartphones in their hands so they can be taking pictures of a plant, having that picture looked at to know whether that plant is under some kind of fertility stress or disease stress, and then a solution coming back.

And then as you start to think about sensor technology and how quickly that's evolving, on a small scale I think that'll be the next one where you're getting that information remotely and you don't have to wait for a picture to come or a text to come. So that's going to come pretty quickly, and it's going to unlock a lot of productivity in those areas.

Muth Any additional thoughts quickly.

May I go back to that technology curve that I referenced, and John Deere, like Monsanto, we have lots of relationships in these developing markets where we're partnering in some cases with not just the grower itself but the local government to try to increase the mechanization. Because even just the basic introduction of a planter can mean significant, significant impacts on productivity.

For example, we have a joint venture in Africa where we're working on developing, increasing the yield in malted barley, and it happens to be with a brewery where the brewery provides the seed genetics, the appropriate seed to do that, and then we've mechanized the system with a simple planter and a tractor and have seen tremendous increases in not only yield but the quality of the product that's actually produced.

And I personally went and visited one of those fields, and I stood there with the farmer and looked at one side that was hand-broadcast and the other side we ran the new system through, and it was night and day.

So, although I talk about these large advancements and these technology-leading customers, John Deere also works on a daily basis around the world serving customers that are very early in the adoption phase of technology.

Muth I think Dr. Garcia had one quick thought.

Garcia ... In animal production, there are now utilization of cameras that can monitor the temperature of the animals so you know if their temperature is changing, and then suggesting that disease could be occurring, and that's externally. Internally, when you interact with an animal, you can have precise therapy now that allows a cow that has mastitis to be treated without antibiotics, which I think is very important.

Muth We're getting very short. Maybe one more quick question, two more.

Question I'm Jennifer Barnhart. I'm associate dean for Research in the College of Engineering at the University of Illinois, and thank you all for being here. So a lot of the discussion has been about precision agriculture and how it's been around for 20 years, as you said. Big data has sort of been around for a lot less. And one of the challenges we have as folks who want to bring big data to the forefront as actually having student access to datasets. Now, I understand farmers own the data from their farms, but has... You know, you have some very large companies on the stage here. How can we work together with universities to put these kinds of ag big datasets... Because I think the Amazons of the world, the Googles of the world are providing datasets for students to work on to get them excited about their field. How can agricultural companies, whether it's on production or machinery, how can they get their datasets in front of our students so they get excited about that aspect of ag?

Muth Do any of the panelists have some programs they'd like to introduce.

Gebhardt Yeah, I'll just mention a couple things from WinField. I mean, the great thing about this audience – I think most of them left now, but all the young people, yeah, they were here, they need to hear this, right? I mean, we have such an extensive intern program, associate program, also fellowship programs. And what we've talked a lot about is we have a lot of that data, right? We have access to millions of acres, all that kind of stuff. Under the right kind of agreement, under the right kind of work, working to help one of our issues, which is people. So that's the collaboration, I think, that you're maybe alluding to. And we work with Dr. Below at the University of Illinois, and I think these guys do too. I mean, we have some fellowships already in place, but that's an area that definitely we've grown that immensely to try to... It's not just around the technology, but it's always about the people that know how to position it and use it. So that would be the one thing I think that we would see as a short-term opportunity is combining – you know, we bring the data, you bring some expertise and the people, and we make something happen that way. That would be a pretty quick solution.

- Question For teaching, so instead of in a more open way.
- Gebhardt Yeah, so just again [inaudible] we're developing sort of academic student kind of versions, those types of things. I'm sure there's probably other things out there as well, so, yeah, I think we'd be open for that. We're not the big generators of intellectual property on the stage here, we're more the consumers, unless it's farmer data. But our data tends to be a little bit more usable and open, but that would be a very good opportunity.
- Muth Next question.
- Question Hello, yeah. My name is Ratnesh Kumar. I'm with Iowa State, electrical engineering. And so I have two related questions. First, talking about precision ag, how precise should a precision ag be? Where do you think is the sweet spot between the resolution that the precision ag needs versus the cost that it takes to do so?
- And the second question is—we talked, the overall goal is of course resource management and improved productivity. And a lot of that has happened in terms of doing genetic engineering in achieving that. What other kinds of problems that you think where engineering together with genetic engineering can come together to solve issues in precision ag.
- Muth I'll quickly respond. On how precise, we use what we call a usefulness metric, so we don't have to be any more precise than what's useful for making a better decision. And that's not a great answer in terms of something highly numerical that you want, but that's a pretty good rule to apply; because you can, as you said, continue to dig and dig and dig in a way that the return just doesn't come there. Any of the other panelists like to address...?
- Garcia With the animals, that's how precise for us, ensuring that the animals are healthy and they behaviorally are feeling well.
- Muth And I think we maybe have one more question.
- Question Hi. I'm Paul McGarby from Des Moines. I'm an investment banker focused specifically in the precision ag. And so my question is more from an M&A standpoint, and again this is more the innovative technological companies on the collection, analysis and also the decision-making or prescriptive tools and services that companies provide. Question—and I understand Monsanto with its purchase of Climate Corp, Precision Planting and Solum up here in Ames, how active are you folks in looking at the market not only for individual platforms to drive revenue but also R&D, deploying information. And I understand the endgame, the holy grail's data, big farm data. But I'm interested from a strategic corporate, big company, how do you look at that? Is that an active endeavor? And I suspect that is an active..., but what's the reach that you folks are doing in the market in terms of looking for those earlier stage technological companies that allow you to grab big data?

Preete

Several questions in one. Here's how our view is. I think if we look out in the future five, ten, fifteen, twenty years and we're in this room, I think there's going to be several sets of businesses around precision ag, because somebody said at the start, this is a big area. I think you're going to see businesses around data transmission, data collection, data storage, data security and compute power. There's going to be businesses around that. You're going to see businesses around devices – it's going to be sensors, it's going to be instrumentation – that are going to provide these. There's going to be businesses around analytics, companies that can take these various sets of information and turn them into insights. John's company has been doing precision ag for a long time, and adding technology to execute mainly the insights that are going to happen.

So I think from our perspective, we think our area of expertise is really understanding the analytics piece as it relates to the crop agronomy – we're not in Claudia's area – but that's where we think our area of expertise lies. And it's helping also get access and look at ways where we can get insights around some of the biology, whether that be soils, plants, the weather, and bringing that together.

And then we see ourselves partnering with other companies who have the expertise in the other areas, like equipment, like some of the sensor technology, instrumentation. Other companies are going to be the best at that. And then companies like Dave's company to help deliver that to the farmer. So that's where we see ourselves, but I don't think... It's not obvious that a single company is going to be able to put all this together; it's going to be a series of partnerships to put this together to get the right solution, the right insight back to the grower.

Muth

Thank you. I think that's a great lead-in to the closing example I wanted to give, that basically we talk about the next frontier, but we're seeing it. And we had several really sophisticated, in-season nitrogen management tools all hit the market this spring. They're different. They're from different kinds of organizations, they're from different backgrounds, but they all help make a better decision around how to manage your nitrogen directly in this exact construct where we want to get more output, more productivity per unit input. And we're seeing that happen, and I think that trajectory and that trend is going to continue in a big way.

So with that, I'd like to thank our very excellent panel. Thank you to the audience that stayed with us, and thanks to the World Food Prize for facilitating.