Advancements in Agricultural Technology Associated with Precision Farming
Presented by Douglas J. Thompson to the:
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(SLIDE 1) Good afternoon. Yes, I'm a farmer from NE Logan County and straight off the combine. I'm also hoping that my dad and wife are keeping things running back home ahead of the rain predicted for tonight and the next couple of days.

My talk will address how Technology is being used in the application of Precision Farming methods – most of this will be from the perspective of how they are used in my farming operation – though I will touch on some other examples, as well.

Perhaps we should start by defining **Precision Farming**. I call it:

(SLIDE 2) *The Application of crop management techniques that measure, analyze and adjust for variability within a field.*

The key here is variability. Our fields are not all the same and it's important that we manage them in ways that account for those differences. This is important to you and me because it ends up protecting the environment (including our river system). It's additionally important to me, because it saves me money.

Two technologies – neither developed especially for agriculture – have made precision farming possible – Computers & GPS

- **Computers** have allowed us to collect and analyze data and then develop and apply plans that address the variability within our fields
- **GPS** has been the primary tool that has made it possible to associate this data with specific locations in the field and thus giving us information about where to make adjustments.

(SLIDE 3) Many of you are quite familiar with GPS applications. Your cell phone is probably equipped with it and perhaps you used one of these to find your way to this meeting!

Let me give you an example of how this GPS and computer technology has transformed how we view and manage one of my fields.

(SLIDE 4) This field is a half-mile square 160 acres. It's what is often referred to as a "Flat, black 160 acres". The field was, for many years, managed as a unit. Fertilizer was applied based on an average of maybe a dozen soil samples taken from the field. We knew that variability existed in the field, but we had no way to manage that.

(SLIDE 5) The GPS data that we collect also records elevation, so I'm able to create topographic maps like this. Notice the high spots (in white and blue) and low spots (in yellow) in the field. We use this information to visualize how water drains off the field. But I show it to point out that this field is by no means "flat". From the high to low point is fall of 19 feet.

(SLIDE 6) Thanks to our county and the NRCS, we now have digitized soil maps available. Each color here represents a different soil type. We can now see that the "black" soils are not all the same. They have different:

- Productivity (yield potential)
- Slope
- Drainage ability
- Natural fertility
- Organic matter
- other qualities

(SLIDE 7) Our combine is equipped with a yield monitor that logs the yield every few seconds by GPS location. With this data, we can create yield maps that easily identify the high and low yielding areas of the field. This example shows the 2007 corn yield - Red = low, Green = high. Of course, these maps don't tell us what caused the variation – soil characteristics, fertility level, drainage problems, compaction, pests, diseases, etc. – only where the differences exist.

(SLIDE 8) One way of handling variation is to create management zones – here shown as grids. We have taken our original 160 acre field and divided it into 55 fields, of about 3 acres each. We collect data for each of them, which we then use to manage those areas uniquely. We currently have soil fertility tests, yield data and variety data for each grid.

(SLIDE 9) Here's an example of the corn yields averaged within each of the grids. One use of this information might be to calculate the fertility removed by the crop, so the amount applied would only replace that amount removed. This avoids over-application for environment and economic benefits.

(SLIDE 10) I have applied my own fertilizer, using variable rate application, since 1996. Soil tests taken in each of those grids, identify the fertility levels and I apply only what is needed to maintain or achieve levels recommended by the U of IL. **(Click)** Our fields are naturally high in phosphorus, so this method often results in some areas receiving no application (for several years). This is a map showing the phosphate fertilizer application one year. Notice the red areas showing 0. This again reduces the phosphorus load on the rivers and is friendly to my pocket book.

(Click) I also use this data to generate prescriptions for my fertilizer dealer for the application of limestone on the field. Again, red is zero application.

(SLIDE 11) Deviating from information about my own farm – I have a friend who farms some irrigated fields along the Sangamon and Illinois rivers in Cass County. In a normal year (not 2009) he would expect the irrigated area of his field to yield more than those outside the circles. **(Click)** So in calculating his nitrogen application rate, he assigns different yield goals to the 2 areas. He also adjusts for the soil types on the field and applies to each part of the field what should be adequate, but not excessive amounts of nitrogen.

One of the more exciting technologies being used on the farm now is autosteer. I want to show how we have used that on our farm.

(SLIDE 12) The tillage methods that we use on our farm are no-till for the soybeans – just as it implies – we plant the soybeans without working up the soil during the year. For corn we use the strip-till system. This involves making one tillage operation in the fall to both apply the nitrogen fertilizer and build a small strip upon which the seed will be planted in the spring.

By only tilling a small strip, we leave most of the soil and crop residue undisturbed and thus resistant to river-clogging erosion. Other benefits are:

- We make fewer trips across the field – saving fuel
- Those trips rarely cross the tilled strip – resulting in less compaction of the soil where the corn grows
- Since we don't till the soil, the moisture doesn't evaporate as fast and stays available for the crop
- The fertilizer is placed just beneath where the seed will be planted - making it readily available to the crop
- Also, the small tilled strip is usually drier and 3 – 5 deg. warmer than the surrounding soil – which helps the seed get off to a quick start.

(SLIDE 13) Nothing's perfect and strip till has its drawbacks:

- Wet fall weather, like this year can leave limited time for the fall fertilizing/strip building. Doing that in the spring may not work many years
- Depending on the winter, it is sometimes difficult to see those strips in the spring. Yet it is necessary to accurately plant the corn on those strips
- Finally, it's best to move those strips slightly from year to year in order to avoid creating "hot spots". It is hard to do that accurately by sight.

(SLIDE 14) The solution to these challenges is RTK Autosteer:

- This is automatic control of the tractor's steering by a GPS guided system
- To achieve the needed accuracy of +/- 1" the GPS needs a stationary reference base station (pictured here). This base sends information to the tractor saying how the GPS location needs to be adjusted in order to gain that exceptional accuracy
- It has the added benefit – since the base station never moves – that the guidance lines set up in a field are always the same year to year
- And – if you have a hilly field, the tractor even adjusts its path for the hillside tilt
- Cost $25 – 30K.

(SLIDE 15) This tractor is set up with the antenna array needed for the RTK accuracy. Antennas on each side of the cab to determine the tilt and direction the tractor is facing. **(Click)** The display in the tractor is used to set up the straight or curved lines to guide us through the field.

(VIDEO SLIDE 16) Here's a video I took while applying the NH3 and building the strips for a corn crop following corn.

- Notice the no hands on the wheel – the tractor drives perfectly straight
- We can turn to watch the implement behind, as the tractor continues to do the driving.

(SLIDE 17) All of this is for the purpose of creating a narrow, mellow strip that can be precisely planted upon in the spring.

(SLIDE 18) The corn is planted with a tractor equipped with the same Autosteer system and it really works! **(Click)** Even curved rows are no problem. Notice the black arrow. This is the row

lying between the 2 passes of the equipment – it's the same width as all the other rows – very accurate.

(SLIDE 19) Another benefit - we farmers enjoy impressing our neighbors and landlords with perfectly straight rows.

(SLIDE 20) I also have equipped my combine with Autosteer. You can see in this video clip the combine take over as it picks up the next guidance line during the turn and it steers right down the row. I really like it for soybean harvest, because the Autosteer ensures that the combine is always taking a full width of crop in every pass. This is actually what I'll be doing in another couple of hours.

(SLIDE 21) These are perhaps side benefits to the Autosteer, but they are significant:

- When they allow your 83 year old father still remain active in planting the crop. You are less tired at the end of the day (able to work longer hours)
- You can watch what you need to instead of where you are going all the time
- You take a full pass each time – being more effecient
- Every pass in the field is established when you set the first pass. So, you can start in the middle of the field and still have that last pass fit perfectly
- Different equipment widths are no problem as the Autosteer can adjust for them
- Visibility is no problem because the Autosteer works after dark and when the dust is blowing
- Finally, we can have time to make management plans and talk on the cell phone or send text messages, without having to give full attention to steering.

(SLIDE 22) A couple of technologies now in use (not by me yet):

Crop sensors, like this, can adjust fertilizer rates based on the apparent health of the plant. Health is sensed by the color reflected off the crop. It may save fertilizer by only applying the amount that the crop actually needs, rather than some estimate made before the crop was even planted.

(Click) **Section Control** is becoming popular due to the high cost of inputs. With seed nearing $400/bag ($175/ac) we don't want to double plant on the ends of fields like we used to. In this picture, the planter rows are shut off 2 at a time and this is all done automatically. The planter control knows – not only where each pair of rows is at all times, but also knows what parts of the field are already planted. It doesn't let the 2 overlap any significant amount. The same technology is used on sprayers to avoid overlap (or double application) in any part of the field. Again – this is good for the environment and the checkbook.

(SLIDE 23) **How will technology impact farming in the future? My predictions:**

- Equipment will continue to increase in the use of GPS and computerized controllers to precisely apply inputs and monitor field activities.
- Sensors will measure soil and crop characteristics on the go to adjust for weeds, fertility levels, insects, moisture – so that we don't apply products unless needed.
- We may irrigate by underground pipes that avoid evaporation and that are not damaged by tillage since the autosteer system knows where they are.
- We'll collect mountains of data about our crops – both for regulatory purposes and to make wise management decisions.

- That data will be moved directly from the tractor to the office and used for cost analysis and agronomic purposes (done now).

(SLIDE 24) This is currently the world's largest planter – 120' wide (3X mine). It will be capable of keeping track of when and where every seed is placed – and what products were applied with it.
(Click) Likewise, we may farm with robots. They may:

- do the planting – logging the same information as the big planter
- do the weeding (on a micro level – weed at a time) using small amounts of chemicals
- do the crop scouting – for weeds, insects, soil analysis

There's room for big and small – limited only by our imaginations and ingenuity.

(SLIDE 25) Questions?

(SLIDE 27) Corn planting video – was on Youtube until John Deere requested removal.

- Notice the open door on the tractor – no driver inside!
- Definitely not approved by equipment manufacturers – UNSAFE!