# HARVESTLAB™ 3000

## DATA AND INTELLIGENT TECHNOLOGY FOR SUCCESSFUL MANAGEMENT


JOHN DEERE

NOTHING RUNS LIKE A DEERE

# RESPONSE TO CURRENT CHALLENGES

## WORK MORE ECONOMICALLY AND SUSTAINABLY WITH THE HARVESTLAB™ 3000

European farmers are facing major challenges. Regulatory and social pressure is increasing, and at the same time they have to work economically. For example, a widespread political goal these days is to increase efficiency in nutrient yield, which is to be achieved, among other ways, through stricter environmental regulations and lower limits for the essential nutrients of nitrogen and phosphorus. Last but not least, more farms than ever are facing the challenge of maintaining or even increasing soil fertility in the long term.

With the HarvestLab™ 3000 sensor, John Deere offers farmers a solution for urgent issues of fertilisation, silage preparation and feeding. The NIR technology not only helps farmers to operate more effectively and economically, but also more sustainably at the same time. By using the HarvestLab™ 3000, the farmers can now keep track of which fertiliser values their load of liquid manure contains, and fertilise precisely based on this data. Additional examples on the following pages show where John Deere's NIR system can help farmers to produce in an environmentally friendly and economical way throughout the year.

The HarvestLab™ 3000 helps farmers to optimise their activities throughout the year, from fertilisation and seeding to harvesting and feeding. The use in three central agricultural applications makes John Deere's NIR system an important component of operational success.

## DOCUMENTING THE HARVEST

Making decisions based on facts

## DETERMINING THE FEED RATION

## THROUGH THE YEAR WITH THE HARVESTLAB™ 3000

The HarvestLab™ 3000 can be used on a slurry tanker, on a self-propelled forage harvester or as a stationary laboratory for feed analysis. This5makes it possible to use the John Deere NIR system year-round. Valuable knowledge is gained from the real-time sensor data and the location specific documentation of the HarvestLab™ 3000. This makes it possible to make decisions based on facts to create accurate application maps for the next field work and to better control and even reduce operating costs, for example, when it comes to silage and feed.

## PRECISE FERTILISATION

## ADDED VALUE FROM MULTIPLE BENEFITS

The data gained makes it possible to use organic fertilisers, such as mineral fertiliser, or to identify a suitable variety of plant. When harvesting silage, the HarvestLab™ 3000 helps to determine the optimum harvest time and the exact dry matter yield. Lengths of cut precisely matched to the dry matter of the harvested crop for optimum compaction and ensiling and precise knowledge of the ingredients form the reliable basis for high-quality silages. As a stationary laboratory on cattle farms, the NIR system provides information about the ingredients of each ration in order to adapt the feed to be economical and tailored to the respective animal. Last but not least, the HarvestLab™ 3000 saves farmers an increasingly important asset: time to invest in the continued development of their business. The whole offering is complemented by the John Deere Operations Center™, the central platform for farmers to manage their operational processes. The tools in the John Deere Operations Center™ help farms to plan, monitor and analyse information in order to optimise the work on site and to increase yield and profitability.

HARVESTLAB™ 3000 FROM JOHN DEERE

# ONE SENSOR OPTIMISES THREE PROCESSES

The HarvestLab™ 3000 quickly and accurately provides the dry substance contents and ingredients of measured substrates.

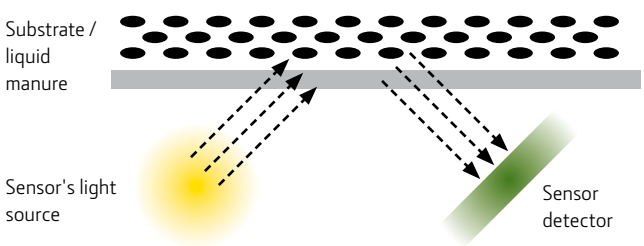
### SPECTROMETER

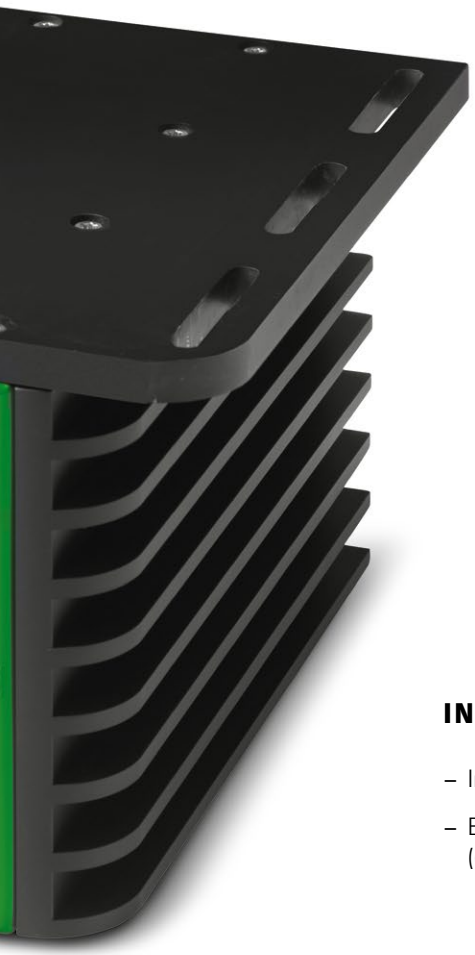
- Planar grating spectrometer (PGS)
- Internal b/w referencing


### MEASURING HEAD

- Undervoltage operated halogen light, longer service life of 20,000 hours
- Robust sapphire flange for connection to harvesters and closed systems

### FUNCTIONAL PRINCIPLE AND SYSTEM SETUP OF THE SENSOR



## INTERFACES

- Innovative plug design
- Ethernet interface, optional ISOBUS (CAN BUS)

## HOUSING

- Completely dust-proof and protected against strong jets of water

# 4,000 MEASUREMENTS PER SECOND

John Deere developed the HarvestLab™ 3000 together with Carl Zeiss, one of the world's leading companies in the field of optics and optoelectronics, and adapted the system to the tough application conditions in agriculture. Emphasis was placed on simple operation in the process. The HarvestLab™ 3000 uses near-infrared spectroscopy (NIR) to determine the various content substances of pig and cattle liquid manure, biogas digestate, fresh harvested crops or silage. The heart of the system is the highly sensitive sensor, which measures near-infrared light reflected off of the harvested crop and provides more than 4,000 measuring points per second. The system has already been officially certified by the German Agricultural Society (DLG) for its excellent accuracy in determining the dry matter content of corn silage and the content substances in pig and cattle liquid manure and in liquid digestate.

# ON THE TRAIL OF NUTRIENTS

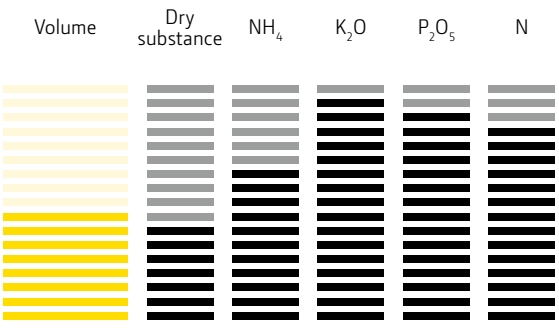
Liquid manure from animals and digestate from biogas plants are heterogeneous nutrient suppliers. Turning them into valuable organic fertilisers requires technology to precisely regulate their application.

***"If only I could use manure like mineral fertiliser."***

## CATTLE AND PIG MANURE, LIKE DIGESTATE, IS A NUTRIENT-RICH ORGANIC FERTILISER.

However, increasingly restrictive fertilisation legislation in Europe today is placing high demands on fertilisation and restricts application rates, application techniques and fertilisation windows. Regulating nutrient application by capping N application and nutrient balances for N and P requires a much better understanding of the actual nutrient content of organic fertiliser. In intensive livestock farming regions, there is the additional challenge of having to transport surplus manure to receptive arable farming regions. Arable farms have several important advantages with manure fertilisation: They can save on mineral fertilisers and produce grain more cost effectively. In addition, they enrich the soil with organic matter. At the same time, many farmers look for reliable information about the substance contents which is usually missing. Until now, successful fertilisation with liquid manure and liquid digestate has been left to chance due to natural nutrient fluctuations and the rapid settling of sediments. It will be more important than ever in the future to use their nutrients in a smart and effective way for environmental reasons and when it comes to legislation and public opinion. This requires an application technique with a precise quantity dosing in order to apply the nutrients homogeneously and comparably to mineral fertilisation.

> ***Fertiliser can be applied exactly as required by specifying nutrient target values and limits in kg/ha.***




## FERTILISING WITH LIQUID MANURE AS NEEDED

The HarvestLab™ makes it possible to apply nutrients such as nitrogen (N), phosphate ($P_2O_5$) und potash ($K_2O$) precisely in kg/ha using a specified target value (e.g. nitrogen) and limit value (e.g. phosphorus). John Deere Manure Sensing can analyse the components of liquid organic fertilisers not only during filling, but also during application, seconds before it comes into contact with the ground. Fluctuations in nutrient content and deposits during transport are thus taken into account and compensated for in real time by automatic adjustments to the ground speed and/or flow rate. Instead of having to rely on a random sample value, the HarvestLab™ 3000 provides statistically validated data with approx. 1 million measurements per load.

# USE THE SLURRY TANKER LIKE A FERTILISER SPREADER

The HarvestLab™ 3000 makes liquid manure into a valuable fertiliser. By measuring in real-time and in conjunction with John Deere Manure Sensing, cattle and pig manure as well as liquid fertilisers can be used as accurate as mineral fertiliser.

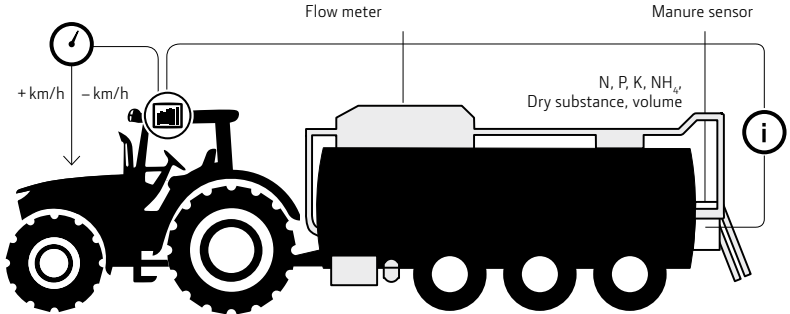
## LOWER MINERAL FERTILISER COSTS

Fertiliser can be applied exactly as required by specifying nutrient target values and limits in kg/ha. Mineral fertilisers can therefore often be done away with or are only needed as a supplementary fertilisation.
By using area-specific information, application maps for a secondary mineral fertiliser application can be created and existing nutrient deficits can be compensated for precisely and according to demand. Depending on liquid manure type, you can typically quantify a nutrient value between 0.50 – 1.66 €/m³, reducing mineral fertiliser input cost.

**TARGET VALUE ENTRY EASIER THAN WITH THE FERTILIZER SPREADER: ONLY THE DESIRED QUANTITY (E.G. – NITROGEN) IN kg/ha HAS TO BE ENTERED IN THE DISPLAY**


# MAXIMISING THE POTENTIAL YIELD

By maximising the potential of each field area, higher yields and a more uniform crop coverage can be achieved, regardless of the source and composition of the liquid manure. Stored crops due to over-fertilisation are avoided and plant health and harvesting conditions are improved, while at the same time the legal limits are complied with. Losses in yield due to under fertilisation are therefore also ruled out and a consistently high quality of the harvested crop is guaranteed.

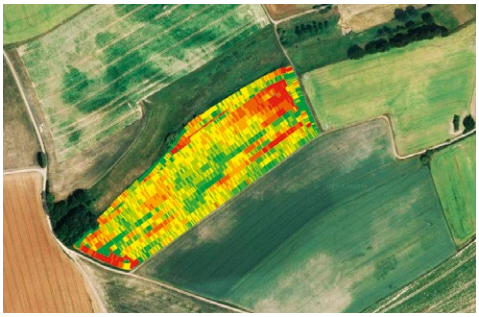



## AS ACCURATE AS A LABORATORY

The John Deere Manure Sensing System was approved by the German Agricultural Society (DLG) for all three important organic fertilisers. After the certification for cattle manure, the DLG test centre extended the recognition to pig manure and biogas digestate.
The latest DLG recognition has confirmed that the sensor works with an accuracy comparable to certified laboratories with chemical measurement methods.
The big advantage is the continuous analysis with more than 4,000 measurements per second. This avoids measurement errors caused, for example, by incorrect sampling, unfavourable storage or delayed measurement. In addition, laboratory results are only available after several days or even after the manure has already been applied. In contrast, the results of the sensor are available for automated application in real time.

## PRECISION AGRICULTURE WITH LIQUID MANURE

In combination with the yield data of the Self-Propelled Forage Harvester, area-specific application maps for liquid manure fertilisation can be created. Since it is known how much of the nutrients were removed from the land during chopping, the liquid manure can be precisely dosed. The HarvestLab™ 3000 constantly compares the actual nutrient levels as the liquid manure is applied with the set target levels or with the prescription map data. The exact application rate is then automatically controlled through a combination of tractor speed and/or flow rate adjustments.




# HIGH QUALITY SILAGE IS THE GOAL

On many farms, high quality silage is the basis for feeding high-yield dairy cows and beef cattle or for producing biogas to meet demand. In addition to adequate yields, high nutrient and energy levels and high fermentation quality are all goals.

High-quality maize and grass silage as basic forage is a decisive factor in the successful feeding of dairy cows and beef cattle. The objective in relation to forage harvesting and preservation must therefore be making sure you have the best quality of silage and achieving high-quality forage. Therefore, the aim is not only to increase the quantity of milk and the quality of meat, but also to promote animal welfare and animal health.

The operators of biogas plants also value high-quality silage, because they know that the silage quality significantly affects the biogas yield. In light of the increasing shortage of space and the increasing pressure to produce a higher energy yield per unit area, accurate and reliable yield measurement is the basis for greater economic efficiency when producing biogas silage. The dry matter content of the crop yield is a key indicator for the shelf life of silage. However, as is well known, this is not the same everywhere in the field. Even in homogeneous crops, dry matter differences of 16% and more were often measured. Individual samples per trailer or even a visual inspection do not provide exact data and are therefore not suitable for orientation purposes, let alone for correctly recording the substances.

| CULTURE | MOISTURE/DRY MATTER (TM) | CRUDE PROTEIN (XP) | STARCH | CRUDE FIBER (XF) | NDF [NEUTRAL DETERGENT FIBER] OM | ADF [ACID DETERGENT FIBER] OM | SUGAR (XZ) | CRUDE ASH (XA) |
|---|---|---|---|---|---|---|---|---|
| Corn | ● | ● | ● | | ● | ● | | ● |
| Grass | ● | ● | | ● | ● | ● | ● | ● |
| Alfafa | ● | | | | | | | |
| Whole-crop silage | ● | | | | | | | |

# PRODUCING EXCELLENT SILAGE

High-quality silage is a decisive operational factor in the successful feeding of dairy cows and beef cattle. The goal must be the best possible preservation of high-quality animal feed that at the same time promotes animal welfare and animal health. The HarvestLab™ 3000 makes important contributions to achieving this goal.


When used on a forage harvester, the HarvestLab™ 3000 achieves more representative and accurate values than conventional sampling methods.

## EXACT DETERMINATION OF THE SUBSTANCES

A high quality harvest is decisive when creating high-quality silage. The quality is not only determined by factors such as the chop length or kernel processing, but also by the silage substances. However, these can vary greatly in maize and grass depending on the time of cutting. In addition to the dry matter content, the HarvestLab™ 3000 also records the essential ingredients of crude protein, starch, crude fibre, neutral detergent fibre (NDF), acid detergent fibre (ADF), sugar and crude ash with high precision during harvesting. Not only can the optimum harvest time be determined in this way, but conclusions can also be drawn about the fodder value of the crop before it is brought into the silo.

Fitted to a John Deere forage harvester, the HarvestLab™ 3000 sensor enables the automated length of cut adjustment based on the dry matter content.

***CONCLUSIONS CAN BE DRAWN ABOUT THE FODDER VALUE OF THE CROP BEFORE IT IS BROUGHT INTO THE CLAMP.***

## DETERMINE SUBSTANCES DURING SILAGE HARVESTING DIRECTLY

On the spout of a John Deere forage harvester, the HarvestLab™ 3000 measures the dry matter content of the crop in real-time. The NIR sensor can also be used for measurements of important constituents during harvesting, with high precision and without affecting the sampling. This means conclusions can be drawn about the quality of the harvested crops before they are used as feed. The operator simply selects the required cut length setting for a certain dry matter content and sets the lower and upper limit values. The cut length is then automatically set for the best possible silage quality using the dry matter content data from the HarvestLab™ 3000.

## PRECISE DOSING OF THE SILAGE ADDITIVES

Silage additives can steer the fermentation process and fermentation quality in the right direction by reducing losses due to faulty fermentation and preventing reheating during silo removal. The data for dry matter and sugar content that the HarvestLab™ sensor measures at the spout of the forage harvester, can be used in real-time during chopping in order to vary the silage additive dosing. In this way, the silage quality is already influenced during the harvest. The automatic dosing system can save you up to 10% of silage additives.


Strong fluctuations in crop moisture in one and the same field require different lengths of cut to ensure optimum silage compaction without oxygen enclosures.

## BETTER COMPACTION OF THE SILAGE

A high storage density must be the goal in order to obtain high-quality, fermentation-stable silage. Good compaction also ensures a more stable silage once the first slice has been taken from the clamp. There are different recommendations for the correct chop length, which vary greatly depending on the dry matter. From a practical point of view, there is much to be said for finer chopping, since this usually achieves a much higher storage density than with longer chop lengths, which can complicate the process when compacting the silage. With increasing humidity, however, a short chop length leads to a "blurring" of the silage heap. The pile becomes unstable, the application of additional layers and the compaction of the silage becomes more difficult. In order to achieve the best possible storage density and reduce the risk of reheating, the length of cut should be regularly adjusted to the dry matter content because the moisture in the crop can vary by up to 20% in the same field. In combination with the AutoLoc™ (automatic length of cut) adjustment of the John Deere forage harvester, the HarvestLab™ 3000 ensures exact adaptation of the length of cut to the changing dry matter content of the silage.

## IMPORTANT BASIS FOR MAKING AGRONOMIC DECISIONS

Many farmers want their contractors to do more than "just harvest". They also want to use the data provided by the HarvestLab™ 3000 to track variety differences based on the harvest amount and quality or to optimise their fertilisation. By analysing and evaluating all field-specific documentation data in the John Deere Operations Center™, farmers can make fact-based decisions for the next seeding and crop nutrition operations. For example, the data of the yield maps can be used in application maps for the area-specific mineral and slurry application for those areas.

**THE LENGTH OF CUT ADJUSTMENT BASED ON THE CROP MOISTURE CONTENT ALLOWS FOR A BETTER COMPACTION AND THEREFORE A HIGHER FERMENTATION QUALITY OF THE SILAGE**


# FEEDING UNDER CONTROL

A high forage performance lays the foundations for profitable milk or meat production. Performance-adjusted and demand-based feeding with corn and grass silage is key to high efficiency in dairy farming and bull fattening.

Rising costs to complete work and purchase feed requires improved efficiency in feeding on dairy and beef farms. Grass and corn silage make up the largest ruminant share. And rightly so, because with high feed prices, it pays off for a farm to be able to produce its own animal feedstuffs, not to mention their importance for sufficient structural supply of the animals and good feed intake.
This is why high quality silage is a key foundation of feed rations on many farms. This requires the individual animal to be supplied with an amount of nutrients, energy and minerals that meet its individual needs. Accurate ration management pays off not only through savings in feed supplements and lower feed costs, but also through better animal health, higher milk yield and higher daily weight gains.
Many farmers are also biogas plant operators. As such, they also value good silage in this branch of business. After all, the silage quality significantly affects the biogas yield. That is why taking continuous measurements here makes sense too. Because if you know the dry matter in the clamp, you know how much biogas can be produced with it.

# RATIONING FEED NEEDS AND ECONOMICALLY BASED

The HarvestLab™ 3000 can also be used as a stationary laboratory on the farm in order to ensure a demand-based feed rationing in cattle farming. By connecting to a vehicle socket, precise measurements can be taken of the silage quality with the NIR system from John Deere, no matter where you are.


High quality silage is a decisive operational factor in the successful feeding of dairy cows and beef cattle.

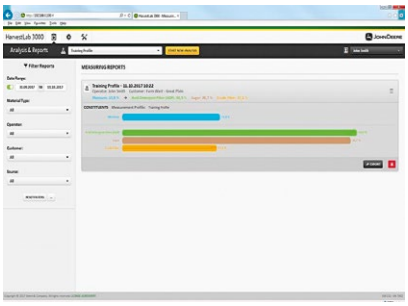
Use of the HarvestLab™ 3000 as a stationary laboratory to determine feed rations.

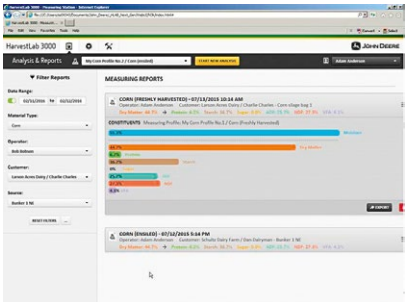
## UNIFORM FEED RATIONS, DESPITE CONSTANTLY FLUCTUATING DRY MATTER CONTENT

Dry matter content and silage substances can vary widely depending when and on which field the harvest took place. Even more than maize silage, grass silage proves to be a very variable product. Daily silage analyses are crucial for proper silage management, correct feed rationing and animal health in dairy farming and cattle fattening. In the winter months, as a stationary laboratory, the HarvestLab™ 3000 can be used to monitor the feed value of silage as it is removed from the silo.

Such fluctuations are critical for an accurate daily allocation of feed. Occasional random measurements on the silage heap do not yield representative values. Constantly analysing the feed quality in real-time with the HarvestLab™ 3000 offers specific starting points for an exact and needs-based rationing.

The user-friendly user interface offers a clear visualisation of the data so you can easily plan winter feeding.

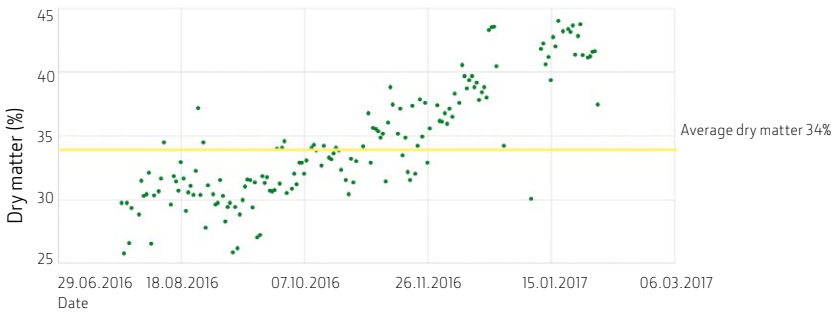




## SAVING ON FEED SUPPLEMENTS

The regular daily analysis of the silage is the appropriate measure to be able to feed a lot from crude fibre and limit the amount of concentrated feed to what is necessary. The right amount of food supplements needed to provide a balanced diet and manage feedstocks more cost-effectively can be controlled in this way for each ration. This not only saves money for unnecessary supplementary feed, but at the same time it also achieves higher yields from milk and beef production, therefore increasing the farm's profitability.

## CORN DRY MATTER




Source: University of Hohenheim, Germany, Philip Kress 2017

***A high-quality silage is important to operators of biogas plants, because it favours a high biogas yield.***

# BIOGAS PRODUCTION

The NIR technology from the HarvestLab™ 3000 makes it possible to accurately determine how big the gas formation potential in the silo is and how much biogas can be produced with it.

## EFFECTIVELY DETERMINING THE GAS FORMATION POTENTIAL

The economical production of biogas requires silage that provides as much methane as possible in the fermenter. In addition to ensuring a maximum yield per unit area, it must be ensured that as much of the energy in the grown biomass as possible reaches the fermenter. The gas formation potential per ton of silage can vary greatly with maize. The most important cause is the strongly-varying dry matter content. When silaging other crops for biogas production, such as whole grain plants or grass, much greater differences in dry matter content and gas formation potential per kg dry matter are to be expected than with corn. The NIR technology from the HarvestLab™ 3000 makes it possible for the business to accurately determine how big the gas formation potential in the clamp is and how much biogas can be produced with it.

The gas formation potential per ton of silage can vary greatly with corn due to the strongly-varying dry matter content.

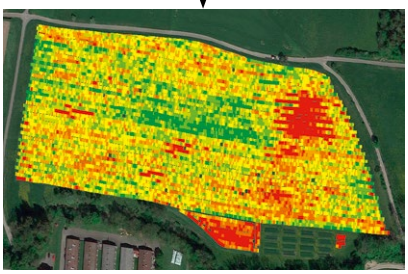
# JOHN DEERE OPERATIONS CENTER™

This is where all of the data comes together. Whether it is the quantities of nitrogen, phosphate or potash applied, or whether it is the dry matter or crude protein yields achieved. The John Deere Operations Center™ can analyse in detail how the fertiliser affected the harvest amount and quality.

## MY OPERATIONS APP

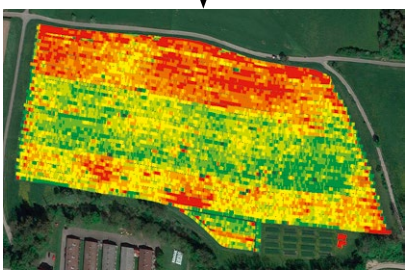
- Machine positions
- Working progress
- Documentation maps

Everything visible in almost real time from mobile devices

## DRY MASS YIELD MAP

It provides information about the quantity, but not the quality of the harvest.

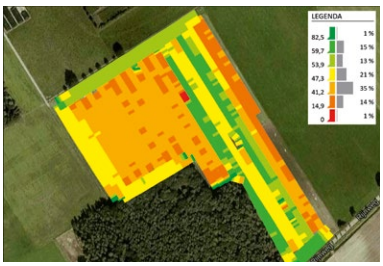


## PROTEIN YIELD MAP

The quality of the harvest can be determined with the HarvestLab™ 3000.

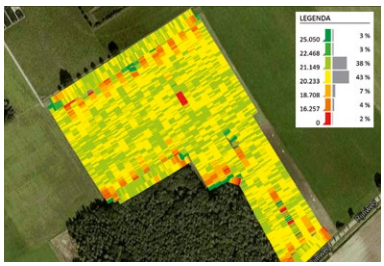
### APPLIED AMOUNT OF NITROGEN IN Kg N/ha

A preselected target value N/ha was applied evenly to the field



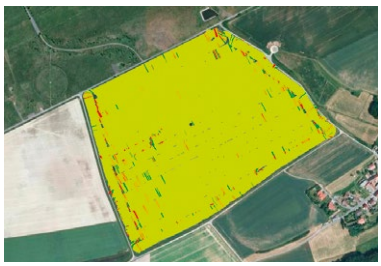

### APPLIED AMOUNT OF MANURE IN m³/ha

During the same crop pass as the liquid manure application rate measured on the left in m³/ha




### 2ND NITROGEN APPLICATION WITH ISOBUS IMPLEMENT

Other fertiliser applications from ISOBUS-capable implements can also be documented



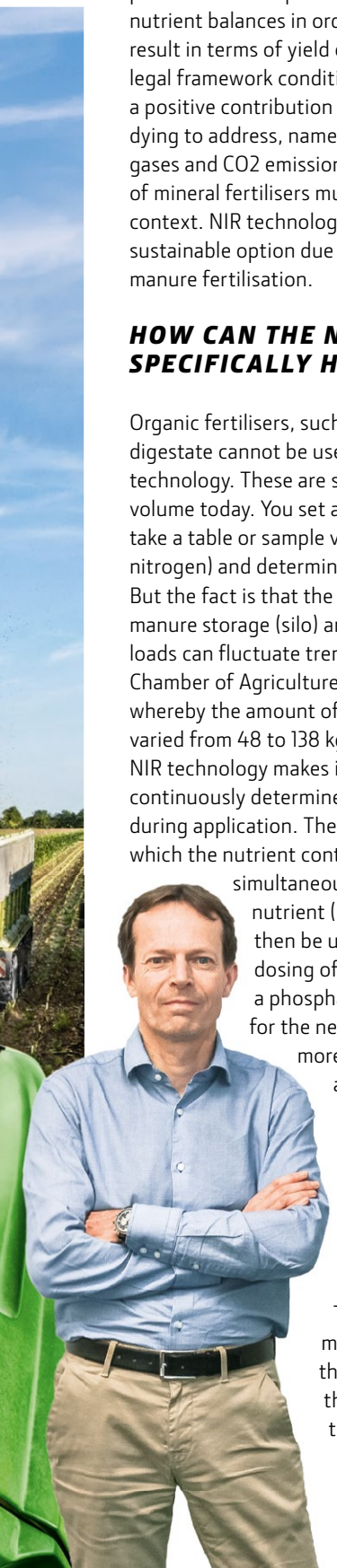
### RECORD DATA AND MAKE SOUND DECISIONS

Farmers make hundreds of decisions every harvest year. It is often difficult to measure the impact of a decision in order to control success. At the John Deere Operations Center™, the information acquired in the field is bundled and represented clearly. This helps to make easy and fact-based decisions. The results of cultivation strategies for example, can be read in the yield or content maps. In the following year, they will make it possible to further optimise planning, increase yields and reduce costs. The data can be transmitted wirelessly from the machines to the Operations Center. It can always be viewed via the Internet or on mobile devices. The data is yours. John Deere uses procedures used in online banking to prevent any loss or misuse of data.

Jørgen Audenaert has been involved in research projects on NIR technology for many years and has been heavily involved in its development and introduction in the field of liquid manure fertilisation. In an interview, the precision farming & NIR expert from John Deere Strategic Marketing talks about the current status and prospects of this technology.

## NIR TECHNOLOGY WILL PREVAIL

According to Jørgen Audenaert, NIR technology can answer some of the burning questions of today's agriculture.



### MR. AUDENAERT, IS NIR TECHNOLOGY ON A GOOD PATH?

Absolutely! The technology allows us to record better and more accurate data about the yields and especially about the quality of the harvested products. We can now use this data to make a quantum leap in accuracy when fertilising and therefore in the economic efficiency of applying organic fertilisers combined with mineral fertilisers. With the NIR technology, every field and every partial field can optimise, among other things, the nutrient balances in order to achieve the best possible result in terms of yield or contribution margin within the legal framework conditions. NIR technology is also making a positive contribution to another issue that farmers are dying to address, namely the discussion on greenhouse gases and CO2 emissions. The energy-intensive production of mineral fertilisers must be viewed critically in this context. NIR technology is a very interesting and sustainable option due to the optimisation of the liquid manure fertilisation.

### HOW CAN THE NIR TECHNOLOGY SPECIFICALLY HELP FARMERS NOW?

Organic fertilisers, such as cow and pig manure, or biogas digestate cannot be used precisely with conventional technology. These are still mainly spread according to volume today. You set a target value (in cubic per hectare), take a table or sample value for the nutrient contents (e.g. nitrogen) and determine the N application rate from this. But the fact is that the nutrient content in the liquid manure storage (silo) and also between different transport loads can fluctuate tremendously. For example, the NRW Chamber of Agriculture examined 142 pig manure samples, whereby the amount of ammonium nitrogen applied varied from 48 to 138 kg/ha based on 20 m3 per hectare! NIR technology makes it possible to directly and continuously determine the nutrient content in real-time during application. The result is a precision fertilisation in which the nutrient contents are precisely measured and simultaneously registered for each individual nutrient (Ntotal, NH4-N, P, K). This data can then be used later for the second and third dosing of fertiliser. If, for example, a phosphate fertilisation is to be carried out for the next season, you already know where more and less has already been applied and can then completely compensate for this.



### WHAT ARE JOHN DEERE'S STRENGTHS COMPARED TO THE COMPETITION?

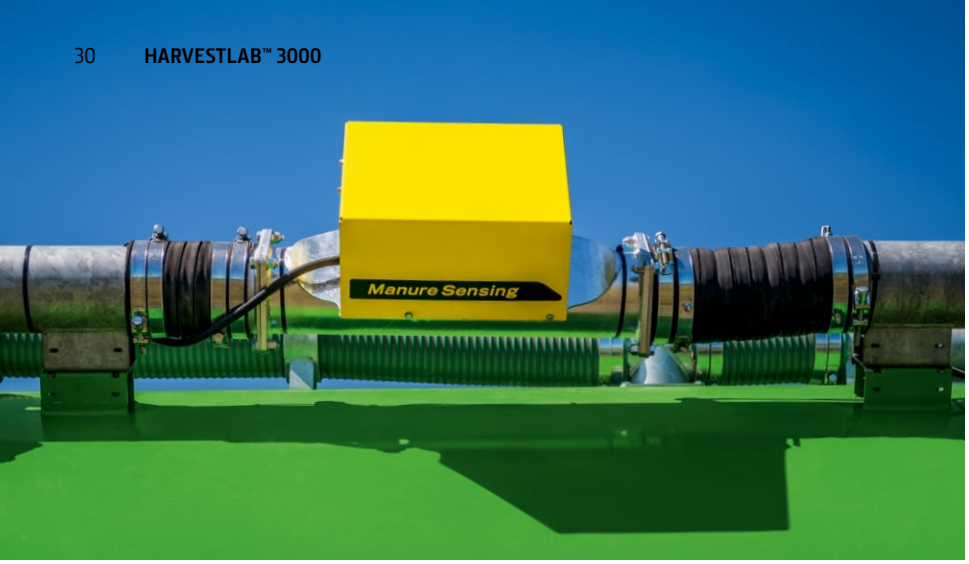
The first difference is that we measure in real-time during the application and control the application rate according to the current nutrient content. Other systems usually determine the nutrient contents during filling and calculate an average value from the barrel – assuming that the nutrient contents in the barrel are homogeneous. The second difference is specifically of interest to contractors. They can use the sensor in three ways: for manure fertilisation, silage harvest and when stationary also for feeding, which shortens the amortisation time. Another strength of the John Deere system is that the application rate is controlled by adjusting the ground speed and/or flow rate. This allows a quick reaction to nutrient fluctuations in the slurry tanker and an even lateral distribution can be guaranteed. The technology can also be used with liquid manure hoses. Last but not least, all the data is recorded and documented in the MyJohn Deere Operations Center. Together with yield maps and soil maps, organic and mineral fertilisation and nutrient balances can be optimised for each field and partial field.

### TO WHAT EXTENT IS NIR TECHNOLOGY ALREADY OFFICIALLY RECOGNISED AS A MEASUREMENT METHOD?

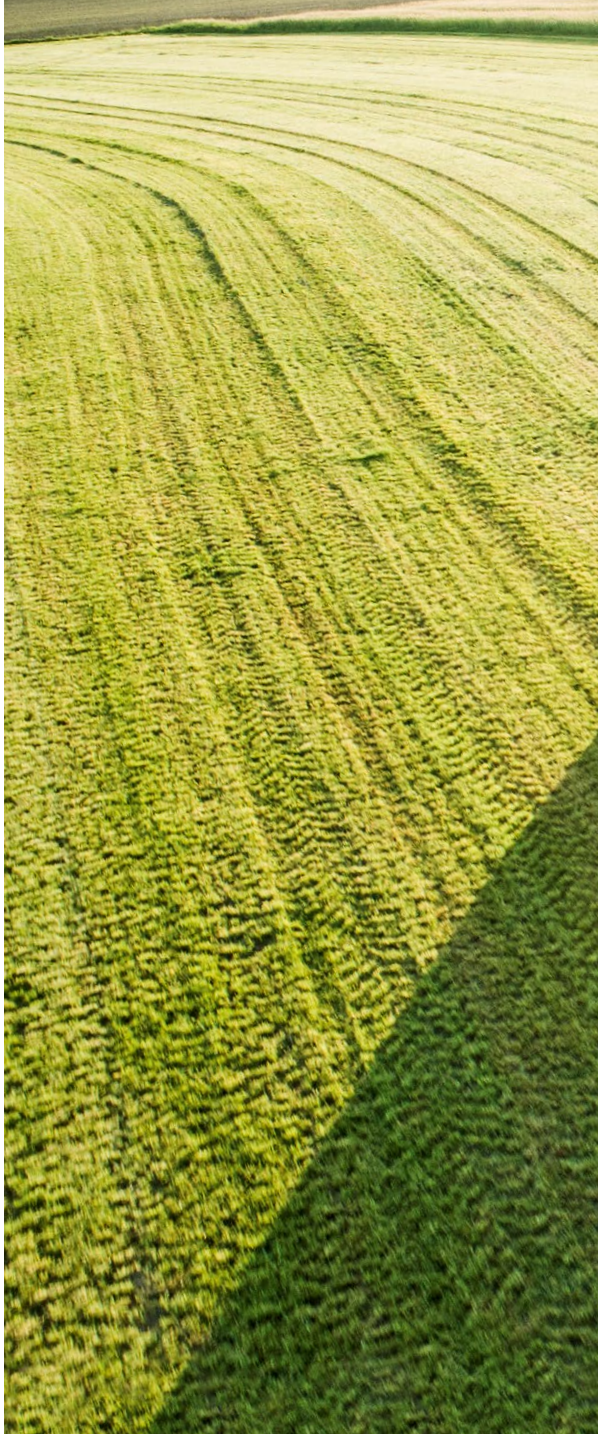
In Germany, our HarvestLab™ 3000 sensor has been certified by the German Agricultural Society for pig and cattle manure and liquid digestate, and it is already officially recognised in the first federal states. There is currently an initiative to expand the recognition to all of Germany. In the Netherlands, a project has also been launched to promote NIR technology as a recognised method for determining nutrient levels in liquid manure during transport and application. During DLG certification, the measurement results of our NIR sensor were compared with those of five laboratories. It was found that our system offers an accuracy that is comparable to the individual laboratories, only with the important difference that we measure the entire contents continuously and in real time.

### WHAT CAN WE EXPECT FROM NIR TECHNOLOGY IN THE FUTURE?

I am convinced that NIR technology will become very widespread. It offers tremendous benefits and supports more sustainable agriculture through the more efficient use of nutrients. In a few years it will be just as self-evident for professional companies as it is today for automatic guidance systems. The calibration models will become better and better and thus even more applications will be possible.







# HARVESTLAB™ 3000


JOSKIN


HarvestLab 3000

# POSITIVE ENVIRONMENTAL IMPACTS

John Deere's NIR system's precision also makes a significant contribution to water protection by optimising nutrient balances for each field or even for specific parts of fields. In addition, positive environmental effects are achieved by substituting mineral fertilisers with liquid manure. To produce 1 kg of nitrogen in the form of ammonia or ammonium nitrate, 0.6 kg of natural gas is needed in the most efficient factories. This corresponds to about 0.8 kg heating oil or about 10 kg $CO_2$ equivalents per kg nitrogen.



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