



Precision route for liquid additions

Machinery Muck and slurry

On-the-go nutrient analysis, advances in electronic machine control technology and soil injection techniques that minimise ammonia loss to the atmosphere help growers make better use of farm slurry and AD plant digestate on arable crops. CPM reports.

By Peter Hill

Planning the use of manures and digestate according to an analysis of nutrient content is nothing new; a test kit can provide an answer relatively conveniently.

But with nutrient distribution so variable within a stored volume of such material, determining its genuine value with any great consistency is much more of a challenge.

Near Infrared Reflectance Spectroscopy (NIRS) and some clever applicator control

electronics appear to provide the answer following three years of collaborative study by research and commercial organisations.

Sponsored by Defra through the Sustainable Arable LINK Programme, the research confirmed that NIRS could provide rapid, low-cost and reliable analysis of total and readily-available nitrogen, phosphate, potash, sulphur and magnesium.

NIRS-based analysis

This led one of the project partners, the Eurofins laboratory testing network, to offer NIRS-based analysis of solid manures and slurries from cattle and pigs at a cost reckoned to be low enough to justify submitting sufficient samples to provide a more accurate picture of nutrient content distribution.

But the Holy Grail for this technology — real-time analysis on board field-application machinery — has been developed such that variability on the day and in every batch can be taken into account.

Dutch manufacturer Veenhuis, now represented in the UK by Suffolk-based Technical Waste Solutions, first evaluated a system heading in this direction with NIRS sensor technology from B&N Proscan on-road tankers transferring digestate to

nurse tanks or direct to application vehicles in the field.

The initial focus was on streamlining documentation, providing an online means of registering slurry and digestate applications without having to physically sample and analyse each batch.

That focus has since shifted to the field, using real-time nutrient analysis to provide an accurate blanket application of a primary nutrient such as nitrogen, or varied rates within a field in accordance with a digital prescription map.

The Veenhuis Nutri-Flow system comprises an NIRS sensor on the tanker inlet that in addition to analysing nitrogen, phosphate, potassium and ammonium also measures the dry matter level in the slurry or digestate as it is sucked on board.

An ISOBUS terminal and GPS positioning package provide the control and mapping elements of the system, which balances variation in nutrient level by applying liquid fertiliser carried in a tank on the front of the tractor.

This fertiliser is applied at each outlet boot of the injector carried on the back of the tanker, and which itself has section control at the distributor head to minimise overlapping where bouts converge.

At this summer's industry awards staged

“ The Holy Grail for this technology – real-time analysis on board field-application machinery – has been developed. ”



The Veenhuis Nutri-Flow system analyses nutrient levels in each batch of slurry or digestate as the tanker is filled, with a supplementary shot of liquid fertiliser supplied from a front-mounted tank.

by ADDBA, the Anaerobic Digestion & Biogas Association, Veenhuis Machines won the 'Making the Most of Digestate' title and makes much of the 'green' credentials of this precision nutrient application system.

Fellow Dutch manufacturer Vervaet — best known in the UK for its giant sugar beet harvesters supplied by importer J Riley — has developed the SmartBox system for its Hydro Trike three-wheel liquid application vehicles.

This can be used with a Trimble GPS system to provide section control of the

rear-mounted injector and to record N, P and K applications based on prior analysis or with a John Deere GPS system and HarvestLab NIRS analyser.

SmartBox will receive prescription maps and send as-applied maps online, and when following the instructions data in a prescription map, it collates data from the NIRS sensor and adjusts the speed of the slurry pump accordingly.

John Deere's Manure Sensing system — developed in co-operation with Belgian tanker manufacturer Joskin — provides ▶

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Fit John Deere's HarvestLab NIRS analyser (yellow box) on a Joskin slurry tanker together with some other hardware and software and application rate in terms of kgN/ha can be regulated automatically.

▶ variable rate slurry and digestate application based on NIRS analysis at the time of application.

It uses Deere's HarvestLab portable analyser on the tanker, a flow meter and pump drive control to regulate flow rate to achieve a target nutrient level.

Alternatively, the operator monitoring the process on an in-cab display can adjust forward speed or the system can be fully automated using John Deere's Tractor Implement Automation (TIA) technology.

Available on 6R, 7R and 8R tractors, TIA enables a job computer on an implement to control certain functions on the tractor.

In the case of a round baler, for example, it is best exploited to reduce the operator's workload by automating selected transmission and hydraulic functions via a two-way ISOBUS link.

When applied to a vacuum tanker, the technology is used to alter the outfit's forward speed in response to changes in nutrient levels within each batch of slurry or digestate in order to achieve the target application rate.

Analysis of the main components of the liquid and its dry matter percentage are carried out at the tanker outlet — 17 times a second with an accuracy range of 0.72%, notes Joskin.

Other components include a proportional flow meter, a GreenStar 2630 display and

GPS satellite receiver, and a Joskin computer that combines the data on driving speed, flow rate and working width.

The ISOBUS protocol is used to transfer data between the HarvestLab sensing device and on-board computers, and to display the data gathered by the sensor, the assigned objectives and the driving speed required to meet the objectives.

Maps can be made from the records and reports for traceability purposes, showing the volumes and level of nutrients applied and therefore enabling detailed management of any mineral fertilisers applied subsequently.

While surface application of slurry and digestate is the attractive least-cost method of utilising these materials, ammonia loss to the atmosphere is significantly reduced by injection beneath the surface.

Relative characteristics of different application techniques

	Low emission spreading equipment				
	Surface broadcast	Trailing hose	Trailing shoe	Shallow injector	Deep injector
Typical range of dry matter	Up to 12%	Up to 9%	Up to 6%	Up to 6%	Up to 6%
Requires separation or chopping	No	Yes (if over 6% DM)	Yes	Yes	Yes
Relative work rate	→→→→	→→→	→→→	→→	→
Uniformity across spread width	✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Ease of bout matching	✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Crop damage	Moderate	Low	Low	Moderate	High
Relative odour	High	Moderate	Low	Low	Very low
Relative ammonia reduction	0%	30-35%	30-60%	70-80%	90%
Capital cost	£	££	£££	£££	££££

Source: Defra

According to Defra's newly-published Best Practice guide to minimising ammonia loss, shallow injection will trim by 70-80% the volume of ammonia typically lost to the atmosphere after splash-plate surface application (see table, above).

This compares with a very variable 30-60% from the trailing shoe technique, which places the liquid into the surface, and 30-35% from a dribble bar or trailing hose.

Moreover, growers who take the injection option when accepting AD plant digestate at an appropriate time of year can

also get free cultivation into the bargain from tillage tools that place and cover the liquor on stubbles or previously cultivated ground.

Rapeseed establishment

With its XTill implement, German manufacturer Vogelsang builds a tool that can also dispense rapeseed or pave the way for separate sowing of maize, sugar beet or oilseed rape into prepared strips of tith.

The XTill ProTerra, which has row spacing fixed at 70cm or 75cm, and the XTill VarioCrop, which has freely adjustable row spacing between 45cm and

The Vervaet Hydro Trike self-propelled tanker can also operate with the John Deere HarvestLab unit to provide automatic pump output control.



75cm, dispense digestate at root level from a rigid cultivating tine.

An added feature of the VarioCrop model is that it can place liquor at two adjustable depths simultaneously.

Duckfoot points

Joskin offers the Terrasoc rigid tine injector with 24cm wide duckfoot points for stubble cultivation and the Terraflex flexible tine with 65mm points for ploughed or pre-cultivated arable land.

Injection spacings of 30cm or 40cm across widths to 7.6m are combined on the Terraflex/3 with a three-row layout for maximum trash clearance.

Joskin's own Scalper macerator is fitted to the distributor head in each case, which uses small freely rotating circular blades to deal with any fibrous material.

Hybrid solution

The Claydon Injector based on the chassis and tines of the familiar Hybrid drill, strip injects digestate directly into stubble at 30cm or 60cm row spacing.

A carbide-tipped leading tine penetrates the soil to a depth of around 150mm to create a void and the following flexible tine places the slurry. A rear harrow sweeps soil over the strip to ensure that ammonium nitrate is not lost to the air and any odour impact is kept to a minimum.

With the added ability to place or broadcast oilseed rape behind the injector, the implement is reckoned to also offer a versatile and cost-effective way of establishing high yielding crops.

Disced digestate

In addition to its CM and CMX spring tine cultivator injectors in widths up to 8.6m, Samson Agro produces the 'SD' incorporator with two rows of 510mm diameter concave discs rather than tines.

The discs are positioned 25cm apart, with digestate applied into the furrow created by each leading disc and then immediately covered by soil thrown from the second discs, which are set to throw in the opposing direction.

A 630mm open crumbler consolidates the resulting tilth as well as regulating the working depth, although a hydraulic depth control system is also available to help keep weight on the tractor for traction.

The company's vertical distributor is used to share out the liquor among outlets covering 5m, 6m and 7m working widths and the entire assembly is galvanised to guard against the corrosive nature of AD plant liquor.



The XTill provides strip cultivation and slurry or digestate injection prior to precision sowing maize – a one-pass oilseed rape seeding system is also available.



The Claydon Injector uses the familiar two-tine arrangement from the company's drills at 30cm or 60cm spacing.

Samson Agro says the 'SD' can incorporate 10-70t/ha and work at up to 18km/h as well as performing effectively at slower speeds.

Joskin's similar two-row disc unit with galvanised components also comes with 510mm diameter scalloped discs working up to 18cm deep ■

Cultivator conversion kits

Vogelsang produces its SynCult liquor application kits for several established short disc cultivators so they can be used for slurry and digestate application, including the Amazone Catros, Horsch Joker, Pöttinger Fox 300D and Väderstad Carrier CRX 425, 525 and 625 models.

The conversion package, which requires no drilling or welding, comprises an adapter frame, a precision liquid distributor, conveying and discharge pipes and all necessary brackets.

While these implements all have discs operating at a fixed angle, the Evers Toric disc harrow injector has stepless adjustment so that the effect of the 560mm diameter discs can be fine-tuned to suit different soils and situations.

It comes in four sizes from 4.65m to 6.45m



Vogelsang SynCult conversion kit is available for a number of short disc harrows, including the Horsch Joker short disc cultivator.

with 30cm disc spacing, and APV pneumatic broadcasting units are available for simultaneous seeding and digestate application.