Vertical rate – the third dimension

MIKE ROBERTS

GPS systems, yield mapping and advances in input application technology are all part of the variable rate precision agriculture revolution that has transformed the two dimensional face of the farming landscape. According to soil researcher Michael Eyres, general manager of Injekta Field Systems, the next step is to use these powerful tools, in conjunction with decades of soil science and some new sub-soil application technology, to add a third dimension: vertical rate; a concept he believes will change the face of agriculture.

Soil variability is a fact of farming life. Walking across a paddock can reveal sandy rises, loamy flats, stony outcrops and areas of heavy clay that often require different management approaches, with the soil characteristics at least as important as the surface features.

Most growers are well aware of variable rate technologies but 'vertical rate' is just as important for farm decision making, according to Michael Eyres.

Michael, general manager of Injekta Field Systems, suggests that digging through the soil surface, preferably with a backhoe, will reveal another dimension of variability, with typically a surface layer of soil relatively high in organic matter on top of a denser layer with less organic matter and higher pH. If we keep digging, he says, we may notice soil layers that are quite different in texture, clay percentage, bulk density, pH and nutrient values.

These variations in characteristics can pose significant challenges for growers and their crops, many of which Michael believes can be addressed using fluid inputs.

THE SOIL CAN TELL GROWERS AND AGRONOMISTS A GREAT DEAL. CONSULTANT MICHAEL EYRES EXPLAINS SOME OF THE MECHANICS AT PLAY IN THIS RED SOIL ON PETE KITSCHKE'S JAMESTOWN PROPERTY.

Furrow management

"Integrating precision fluid delivery, precision mapping and guidance technology enables a previously unachievable level of management control in the furrow at sowing time," Michael said.

"In the future a liquid delivery platform for any cultivation system will need to have row-to-row and second-by-second accuracy of liquid placement in-furrow to match the management expectations of farmers."

The ability to manage vertical soil variation to this level will depend on accurate and appropriate information about the soil horizons in a paddock, which will enable development of strategies built around liquid delivery systems such as those built by Adelaide-based Peter Burgess of Liquid Systems.

Liquid Systems can design delivery systems that enable a grower to vary the rate of four or more streams of liquid and deliver them at different locations and depths during the seeding pass. This means nutrients, inoculants, fungicides or soil conditioning agents can be placed close to the seed or further away, either laterally or vertically, depending on the input, the crop, and the soil characteristics across the paddock.

"The beauty of Peter Burgess' system is that it gives you consistency of flow," Michael said. "There's no intermittent flow so you can achieve the accuracy of flow and placement that growers who are spending big money on fungicides and inoculants require.

"A liquid delivery system needs to run like a state of the art hydraulic system, all linked into your cab monitors and controllers. There are cheaper systems but they don't have the accuracy.

"Growers can start at different levels but they always will eventually move to a more robust and accurate system."

Data

Precision agriculture generates large amounts of data. However, for growers to benefit from this it needs to be interpreted and transformed into information that can be used to make sound, informed decisions.

Data such as yield and protein levels across a paddock at harvest can be gathered and combined to create 'predictive intelligence' that, when combined with soil structural information and data from nutrient analysis, can be used in strategies to drive the use of liquid delivery systems to build healthier, more profitable soils and crops.

Using liquid delivery does not imply a complete management change or move away from granular fertilisers, Michael

said. Liquid delivery should rather be viewed and applied as complementary to a granular fertiliser use. "The opportunity presented by liquid delivery technology will be missed if it sparks a competitive battle between 'liquids' and 'granular'.

"Growers need to improve their production performance to meet the food and energy needs of the future and using liquid systems in conjunction with the correct data management, precision engineering, recognition of cultivar requirements and correct diagnosis of soil condition can help achieve that," he said.

"Accurate diagnosis, flexible and accurate liquid delivery systems and precise application technology are the keys to the future.

"The good news is, they are available today."

Michael sees liquid delivery technology as an 'enabler' that permits more effective use of resources and, combined with accurate data capture and comprehensive, season-long soil and crop analysis, can provide growers with a variety of tools, methods and techniques including:

1. Variable rate fertiliser

Liquid fertiliser delivery with two or more delivery outlets, variable direct injection systems matched to yield, climate influence and precise soil maps, GPS guided sectional shutoff, individual line blockage monitoring, row to row and second by second liquid delivery accuracy with no intermittent flow. Deep band, side band and inter-row placement of solutions.

2. NPK nutrition

Many different combinations of NPKS starter fertilisers, deep banded and side banded nitrogen solutions, sulphur solutions, potassium solutions, phosphate solutions and more can be applies as fluids in furrow.

3. Micro nutrients

Trace elements can be delivered as stable fluid solutions into the furrow during the sowing pass. These micronutrient mixes can be designed to suit individual soil types and specific cultivar requirements.

4. Soil conditioners

Deliver liquid soil conditioner and ameliorant solutions into the furrow at planting to increase the water harvesting performance of conservation tillage, change and manage soil variables such as pH and electro conductivity (EC) and improve soil structure and stability values.

USING THE RIGHT FLUID PRODUCTS IN-FURROW AT SEEDING CAN AID SOIL RECOVERY FROM COMPACTION CAUSED BY HEAVY MACHINERY.

5. Nitrogen and phosphate efficiency

Administer liquids in-furrow that stabilise nitrogen fertilisers and inhibit nitrogen loss through volatilisation. Administer a solution in-furrow to lessen the phosphate tie up affect due to the presence of elements such as iron, calcium and aluminium.

6. Compaction in furrow

The size and weight of farm machinery are continuing to increase. This extra weight combined with the inherent chemistry of many soils results in soil compaction problems. Application of effective in-furrow fluid solutions at planting can aid soil recovery from compaction caused by heavy machinery passes at sowing.

7. Inoculants in furrow

The ability to deliver liquids containing inoculants and germination stimulants direct into the furrow with the seed during the seeding pass eliminates the need to pre-treat grain with inoculants, reducing labour requirements and avoiding problems with blocked augers and wet grain.

8. Herbicide burden in soils

Offset the risk of detrimental herbicide burdens in soils with precision placement of necessary micronutrients (such as manganese with glyphosate and zinc with sulfonyl ureas) or biological agents to facilitate herbicide degradation.

9. Waste streams in furrow

Accurately place large volumes of high-nutrient fluid waste material such as effluent, treated liquid feedstock, manures, composted liquids and similar below the seed at planting

10. Soil chemistry

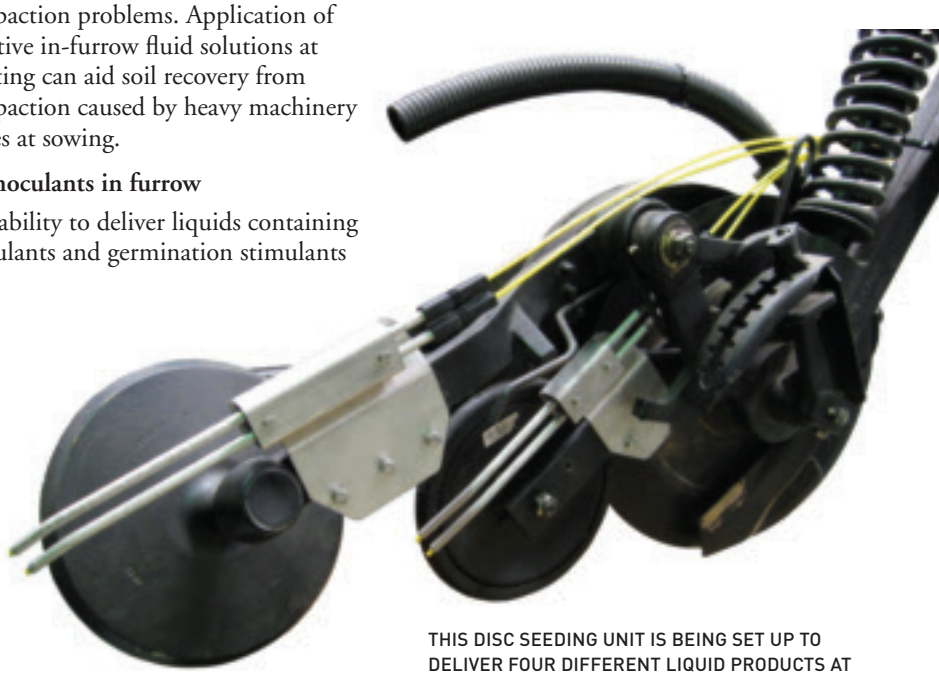
Use of liquid solutions in furrow to manage the effect of detrimental soil characteristics such as salinity, sodicity, aluminium hydrolysis and excess bicarbonates, boron or manganese.

11. Non-wetting soils

Delivering a surfactant solution into the furrow in non-wetting soils. These materials can be banded with seed and fertiliser and/or applied on the surface above the seedbed.

12. Nutrient holding capacity

Application of fluid fertilisers plus micronised (very finely milled) highly reactive clay suspensions into the furrow at planting to increase nutrient holding capacity (CEC) in sandy soils.



THIS DISC SEEDING UNIT IS BEING SET UP TO DELIVER FOUR DIFFERENT LIQUID PRODUCTS AT DIFFERENT DEPTHS DURING THE SEEDING PASS.

13. Water

Add water into the furrow at planting to increase chance of seed germination, avoiding 'too dry to sow wet, too wet to sow dry' scenarios. Adding water can also extend life of inoculum in dry soils.

14. Nutrient uptake

Apply materials that increase the effectiveness of fertiliser applied at sowing and the effectiveness and uptake of nutrients already in the soil (e.g. adding copper solutions in furrow in certain soils can enable plants to make better use of applied zinc).

15. Vertical rate: same soil – separate horizons

Individually address and manage the soil condition of different soil horizons simultaneously during a planting operation (e.g. nitrogen can be deep banded under the furrow and starter fertiliser can be added with the seed higher up in the profile).

16. Fungicides / Non-toxic Nematode Control

Deliver fungicide solutions into the furrow at planting to control root disease and also add a 'species specific' nematode control agent in the same pass.

JUST GETTING STARTED

Precision agriculture has 'been around for while', but Michael Eyres thinks it is just getting started.

In fact, it may be just entering another 'dimension'!

"Agriculture is one of the most technically advanced industries in the country and it will be more so shortly," Michael said.

"We think of farming as engineering, electrics, genetics, biochemistry, hydrology and so much more! It's the most diverse and entertaining industry there is!

"With the computer-based systems available today we can access all of the historical soil survey data from the work done in the 1920s and 1930s and punch all the relevant information into what we now do.

"That information is even more valuable now than it was years ago because we have new techniques and ways of looking at soils that were not available in the past.

"We have better instruments now to interpret older sets of data.

17. Tilth

Tillage from the seeding pass can make positive changes to the seed environment, depending on soil type and condition. Delivery of specific pore stabiliser solutions can improve the effectiveness and longevity of the tillage intervention by improving porosity, infiltration, hydraulic conductivity, pore connectivity and capillary action in the soil.

18. Hygroscopic gels

For seed moisture control in furrow.

19. Biological control agents

Plant growth promotants (hormones), biological disease-suppressing metabolites, rhizosphere root stimulants, fungal and bacterial stimulants.

For more information: Michael Eyres, http://www.injekta.com.au or Peter Burgess, http://liquidsystems.com.au