Fluid News

December 05

Farmer Profile > Ted Stringer

In Brief

- North of Central Eyre Peninsula - Kyancutta
- 1100 hectares of wheat and 400 hectares of barley
- Soils - From grey sandy soil through to fairly good loamy flat
- Minimum till farming, rip up about half and sow and the other half direct drill

what motivated Ted Stringer to make the change to fluid fertilser is the ability to place nutrients including trace elements in the right position, along with encouragement and support from Tim van Loon, a local farmer.

'Fluid fertiliser is ideal for putting trace elements in the right position. I used to ground spray with zinc and then work it in with the machine. On my zinc deficient farm fluid is much better for getting it right to the root zone,' Ted Stringer said.

Ted worked out that even if fluid fertilisers didn't work for him the benefits of being able to place trace elements so accurately were still worth the change.

Timing was perfect, as Ted was about to purchase new machinery. He bought a John Deere bar and hopper (1840) with 10 inch row spacings 44 foot wide, and a 1910 195 bushel twin box hopper with narrow points and press wheels on it. He found it fairly easy to obtain the equipment he needed.

'A few blokes have already done the pioneering work and I was able to use them for advice. Liquid Systems in Adelaide have good equipment, it can be expensive but I've had no dramas,' Ted said.

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From the editor

Jim Kelly

The acceptance and adoption of fluid fertilisers in WA and Queensland has been phenomenal.

Liquid Systems have reported that they are extremely busy manufacturing equipment for these two regions.

This raises the question of why there isn't the same rate of adoption in the Southern Australia grain belt; particularly, on calcareous soil where there is the potential added benefits of increased P availability, higher yields, and disease suppression.

It is ironic that world-recognised fluid research has been led and conducted here in South Australia yet we seem to have the slowest rates of adoption. This is really perplexing when you consider that local growers have more information and probably more to gain than growers in other states and countries.

We will look at this issue in the next edition of the Fluid News.

If you have any thoughts about barriers to fluid adoption could you please share them with us? We are happy for you to ring or simply email us with you thoughts.
In the next edition we will have a round up on the Fluid Fertilizer Foundation Annual Forum.

Contact Jim Kelly:
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Fluid Fertilizer Foundation

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Ted was also able to build some of the equipment he needed himself. He built a fluid trolley, bought the components and put it together. The fluid delivery system which bolts on to the cultivator and the electronic switching taps and filters all came from Liquid Systems.

Last year Ted used a phosphoric acid base mixed with urea dissolved with trace elements. He intends to do the same this year as well as adding a corrosion inhibitor.

'With the 10 inch row space I have gone back to 90L per hectare with 5 units of P and 6 units of N. The trace elements are 1kg of elemental Zinc and manganese as well as 200g of copper as sulfate,' Ted said.

Ted enjoys the fact that he can have a 'different brew' for every paddock if needed and that he no longer has to handle messy fertilisers.

'It is a dream going through seeding without the problem of wet weather making DAP fertilisers sloppy and blocking air-seeder hoses and heads. With fluids I hardly had a blocked hose all seeding,' he said.

The main issue people need to be aware of is that fluid fertilisers are very harsh on metal. Phosphoric acid spillages need to be cleaned up quickly to prevent corrosion and skin contact should be avoided. However, Ted says it is 'no worse than most other chemicals used on the farm.'

Supply is another area that people need to be aware of and work on to get it right. However, Ted says there are other people that have travelled the path before who are more than willing to lend advice and support. It is fairly readily available as the acid Ted uses is an Australian product out of Melbourne.

'This year I have been fortunate, 4-5 farmers have formed a group and we have worked out what we need and put in a bulk order. This has worked well, last year phos acid was $1100 per tonne and this year it is $800. A savings of $60-80/tonne is due to the bulk order and the rest is due to us ordering in August/September for delivery at the end of February start of March this year. The other good thing is that harvest money is in to pay for it,' Ted said.

'The trace elements and urea are also readily available. I get together with other farmers and place an order as it saves us a bit', he said.

Ted had a problem in his first year as the supply of phos acid didn't eventuate and he had to use a clear liquid from South Africa instead. It was a good product supplied by Fertisol that didn't cause any blockages, but it was 12-13% more expensive.

This year Ted aims to work on improving his mixing time before being able to take to the paddock.

'In the first year it took an hour to mix enough for 75 hectares, this year I am going to dissolve trace elements in late March to mid April and store it in a tank so I can simply transfer as many litres as I need. This will save a lot of preparation time during seeding.

The first few years have been a steep learning curve coupled with hard work to get it right. Buying quality equipment and product is also important.

'I would advise people to buy quality fittings and equipment from the start. Get good fittings so they aren't eaten away by the corrosive nature of some fluid products.

'The fittings I bought were 30-40% more expensive, but they have paid for themselves - there is no deterioration as yet and I have used them for one and a half seasons so far. Ordinary poly fittings may only last one seeding,' Ted said.

Ted says there is a lot of research out there that shows good yield increases on grey calcareous soils, and some research into fungicides that can be mixed with fluids would be good. He thinks the next big step for fluid fertilisers is encouraging 20-30% of farmers to make the change so as to decrease costs.

'Plenty of farmers spend $20-30K on a guidance system and think they may get a benefit. I spent $25K on this set up and know there is a benefit,' he said.

Ted believes fear of the unknown is the major hurdle stopping more farmers converting to fluid fertilisers.

'I have found fluid fertiliser people are very eager to share their knowledge and give advice. The fears people have are very much about the uninitiated taking the first step. Encouragement and advice from Tim van Loon convinced me to take the bull by the horns and have a crack, and I am very happy with the results,' Ted said.

Testing a Range of Australian Soil Types for their Response to Fluid Fertilisers

Therese McBeath, Mike McLaughlin, Mark Conyers, Mike Bolland, Roger Armstrong, Mike Bell, Bob Holloway, Caroline Johnston and Enzo Lombi

Introduction

A glasshouse trial was conducted to screen responses in wheat to fluid and granular P fertilisers in a range of predominantly neutral and alkaline soil types (McBeath et al. 2005). Due to the observation of fluid responsive low pH soils we decided to repeat this work using a wider range of soils from all of the major grain cropping regions of Australia, and focus on acidic and neutral pH soil types.

What did we do?

In the second experiment we compared the response of wheat (cv. Yitpi) to two fluid P fertilisers (ammonium polyphosphate (APP) and technical grade monoammonium phosphate (TGMAP)), one granular P fertiliser (monoammonium phosphate (MAP)) and a control of no P added.
P was applied at a rate equivalent to 12 kg/ha and banded below the seed. All other nutrients were balanced and mixed throughout the pot. Wheat was grown to mid tillering (4 weeks of growth).

What did we find?

93% of soils were responsive to P, while in 21% of soils wheat was significantly more responsive to a fluid P source than to a granular P source. This equated to 15-50% increases in biomass of fluid over granular at mid tillering. An example of a fluid responsive soil comes from Culcairn NSW, where there was a significantly greater response to APP than to MAP (Figure1).

Control APP TGMAP MAP

Figure 1: Culcairn NSW, pH 5.91, Colwell P 22.4mg/kg, biomass APP 1.25 x MAP.

Where to next?

We are currently gathering a large amount of information about the soil characteristics from the 57 sites that have been evaluated so far (see Figure 2 for geographic range of sites).

We are gathering this information in order to determine if there is a soil characteristic or combination of soil characteristics that underpins the response to fluid over granular fertilisers. This knowledge would enable us to more strategically identify suitable field sites for testing of fluid products. This work is ongoing.

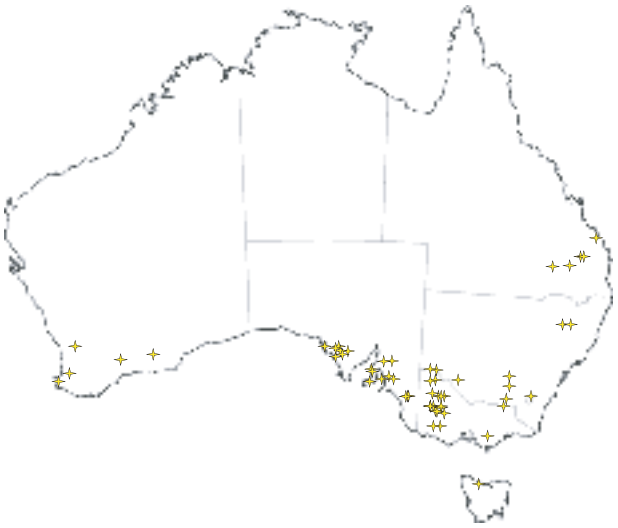

Figure 2: Sampling sites for both Glasshouse Trials

Reference

McBeath TM, Armstrong RD, Lombi E, McLaughlin MJ, Holloway RE (2005) The Responsiveness of Wheat (Triticuum Aestivum) to Liquid and Granular Phosphorus Fertilisers in Southern Australian Soils. Australian Journal of Soil Research 43, 203-212.

Ausplow

Ausplow manufactures the highest quality precision seeding machinery in the Australian agricultural industry, while ensuring leading research and development into more efficient, uncomplicated and productive designs.

John Ryan (Managing Director) has been directly involved in the development of agricultural mechanical systems for more than 30 years. He has established a business in Western Australia, which has grown into one of the most innovative businesses in WA on the cutting edge of precision seeding technology and soil conservation.

Uncomplicated products appeal to farmers and give them confidence in using the equipment. “Doing the job right” ensures Ausplow products have exceptional reliability, because they understand the importance of not stopping.

Ausplow use the DBS (Deep Blade System™) three-slot system that provides deep under-seed cultivation, a shallow bed for seed, defined ‘slot’ trench for water harvesting and a protective environment for germinating seeds. The DBS modules are designed for separate seed and fertiliser placement, ensuring:

- Correct seed depth
- Precise fertiliser placement
- Subsoil cultivation, (vital for root disease control)
- Exact environment for the seed
- Cost-effective chemical usage and safe application.

Dr Bob Holloway (SARDI, Minnipa Research Centre) and his team chose the Ausplow DBS system for their experimental fluid fertiliser program.

They considered it an ideal system for fluid and granular products, providing the flexibility, accuracy and control of seed and fertiliser placement required for detailed nutrition research. They found the DBS system to work well in light soils through to rock out-crops.

Ausplow award winning multi-stream PDS (Precision Delivery System) is designed so that all tanks are able to deliver granular and liquid products. Liquid product is delivered by a positive displacement pump along two separate lines, through non-drip nozzle bodies and using nozzle orifice plates to control flow down to 50L/ha.

Heavy duty polyethylene tanks utilise the Ausplow designed stainless steel tank lids for easy opening and quick locking. A 200mm (8") loading auger provides for easy filling of tanks. All equipment and fittings are of the highest quality and are proven to meet the demands of the most corrosive fluid and granular products.

The Ausplow system allows farmers the flexibility to select from 9 models. The latest model released is the M17000LS, designed to cater for seeding programs where a large capacity liquid tank is required in conjunction with two other products (typically seed and compound fertiliser). The M17000LS negates the need to tow a separate liquid cart, yet still offers significant fill capacity. The M17000LS uses two 4500 L granular tanks and a combined 8000 L centre liquid tank. The M17000LS is configured with the following features, not offered on other multistream models, as standard equipment:

- 1 x liquid tank option
- 1 x dual 110lt enviro drum carrier
- 1 x 20lt hand wash tank
- 1 x Dosetron precision chemical dosing unit.

The Ausplow system provides farmers with the flexibility to meet their own specific needs. The system can be configured for fluid or granular application. The hydraulic tines not only provide the stability to ensure the optimum operation of the DBS system, they also have the strength to handle the most difficult conditions Australian farmers face.

For further information about Ausplow products or dealers contact:

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Horwood Bagshaw

Proudly South Australian

From the first winnowing machine produced in 1838, Horwood Bagshaw have based their ingenious designs and practical engineering on the needs of Australian farmers. Today, nothing has changed.

The strength and success of Horwood Bagshaw still lies in their ability to incorporate ideas from people who rely on their equipment to maximise farmers' income. Horwood Bagshaw combines this 'local knowledge' with the latest agricultural research, current trends in techniques and the needs of new crops. This results in machinery that is guaranteed to help you maximise your yields.

It is not surprising that the design team at Horwood Bagshaw were quick to acknowledge the potential benefits that fluid fertiliser can offer Australian farmers on calcareous, acid and alkaline non-calcareous soils. All trial results from fluid fertilisers were equal to or better than granular fertilisers. The benefits are:

- Improved plant nutrient availability; increasing yield.
- Ease of mixing a specific formula for differing soil types and application using variable rates; reducing costs.
- Liquids can increase the coverage capacity of equipment between refills; increasing efficiency.
- Increased accuracy of placement and ease of deep-banding; improving yields.
- Ability to include trace elements and herbicides.
- Ease of liquid handling and storage.

This led to the development of a Liquid Airseeder that has the design qualities and benefits that farmers have grown to expect from other machines in the Horwood Bagshaw range.

Specifications

	A Frame 2000 Model	Quad 13000 Model	Quad 19000 Model
Liquid Tank	2,000L	4,500L	6,000L
Granular Tank		8,750L	13,200L
-Fertiliser	n/a	4,250L/3,550L	6,000L
-Seed	n/a	4,500L/5,200L	7,200L
Flush Tank	300L	500L	500L

Plumbing Kits

Plumbing kits for cultivators, with delivery rates at the nozzles of 30L/ha to 200L/ha, are available from Liquid Systems (SA).

Design and Operation Features

- The liquid circuit has two filters to eliminate any nozzle blockages caused by particles in the liquid. These filters are located externally for ease of cleaning.
- The pump, filter, lines, nozzles and main tank can be flushed in the field following use.
- A flush tank is incorporated for hand washing and ease of flushing components in the field.
- Flow rate is controlled via Farmscan or KEE controllers and can be adjusted on the run.
- The pump is located on the front of the liquid control box and is driven by a constant speed hydraulic motor.
- All connections are clearly marked as to their function to enhance understanding of the system.
- Plastic tanks are located on the front of the chassis to maximize the weight distribution.
- Filling is done using camlock couplings through the bottom of the tank so that faster fill rates can be achieved, and the fill connector can be used for draining the tank.
- Twin agitators, fixed in the base of the tank, create a swirling of the tank's contents.
- The main tank can be easily accessed for maintenance by two large lids and an internal ladder.

For further information contact Horwood Bagshaw:

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Fluid fertilisers: how did they fare in Victoria in 2005

Dr Roger Armstrong; Vic DPI

Field trials were conducted at two sites in the southern Mallee (K H and L Barber's at Birchip and the Birchip Cropping Group's field day site at Birchip) and one on a cracking clay soil at Dooen in the Wimmera to assess the responsiveness of wheat to fluid and granular forms of phosphorus (P) fertilisers.

Colwell P values for the top soil ranged from 20-39mgP/kg and calcium carbonate levels were <5% across all sites. Two forms of fluid P (APP and phosphoric acid) were compared with two forms of granular P (DAP and TSP), which were applied at rates of 0, 4, 8, 12, 16, and 24 kg P/ha. All applications had a total of 50kg N/ha applied; nitrogen applications were balanced using granular urea. Further to this, a basal application of zinc was applied prior to sowing.

Early growth – mid tillering

Early growth at all sites responded to P fertiliser. However, fluid forms of P (APP and phosphoric acid) created early vegetative growth responses, of up to 58% more than the granular at low to moderate rates of P (4 to 16 kg P/ha) at Birchip Cropping Group in the Mallee and at Dooen in the Wimmera. However, there was generally little difference between the types of fluid P applied.

Grain yield

There were no grain yield responses to P on the Mallee soil at the Barber's site; yields responded equally to granular and fluid P applications at the Birchip site.

However, at Dooen, in the Wimmera, the fluid P produced nearly a 10% (0.24t/ha) yield response at application rates of 4 to 12kgP/ha.

Grain yield response of Yanac wheat at Dooen to P fertilisers in 2005

All sites in the 2005 growing season experienced extremely dry autumn conditions and a late break (mid June in Mallee; late June in Wimmera). The subsequent period from July to early September was dry but rainfall following flowering (grain filling) was above average at all sites (Table 1).

In similar trials in 2003-2004, fluid fertilisers clearly outperformed granular forms of P fertiliser at the Barber's site in 2003, but had no effect in 2004, which was characterised by low growing season rainfall and crop failure. Fluid fertilisers outperformed granular forms (at equivalent rates of applied P) during the vegetative stages of growth (mid tillering) at Dooen in 2003.

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Key soil properties, rainfall and average grain yield at 3 trial sites

Site	Colwell P (mg/kg)	CaCO3 (MIR) (%)	Phosphate buffering capacity (MIR)	DTPA zinc	Rainfall (mm)			Mean grain yield (t/ha)
				mg/kg	Jun-Jul	Aug-Sep	Oct-Nov	
Mallee (Barbers)	21	2.4	46.5	1.29	88	55	109	1.79
Mallee (BCG Birchip)	39	4.6	123.9	1.60	86	56	90	1.78
Wimmera (Dooen)	20	1.1	36.7	1.22	59	62	95	2.63

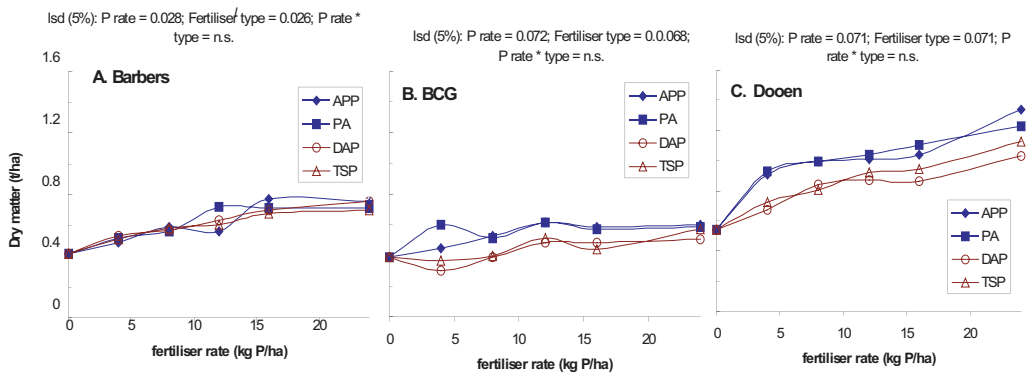

Figure 1. Dry matter response at mid tillering of wheat cv. Yanac to either fluid or granular P fertilisers at three sites.

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Glasshouse trials in 2002-03 demonstrated that fluid forms of P can produce significant early growth responses over granular P on the majority of alkaline soils of the Victorian Mallee and Wimmera. Although there have been some encouraging results, it is yet to be proved conclusively that fluid P can offer Victorian farmers the same yield advantages as demonstrated in South Australian research.

Experimentation is currently in progress at DPI (Horsham) and CSIRO (Adelaide) to improve our understanding of the effect of water availability (including its timing) on the relatively efficacy of fluid and granular forms of P. This work has been undertaken to help explain observed results and to assist growers when assessing the financial feasibility of converting their operation to the use of fluid fertilisers.

For further information contact

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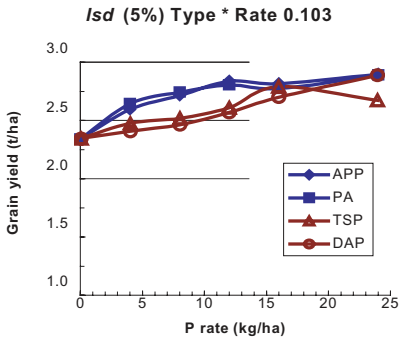

Grain Yield response of Wheat cv. Yanac at Dooen to P fertilisers in 2005.

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Understanding how Phosphorous reacts with calcareous soils

Enzo Lombi

Scientists at CSIRO and DPI Victoria, in collaboration with colleagues in North America, conducted an investigation to assess how P from fluid and granular fertiliser reacts in highly calcareous soils at a molecular level.

The experiments were conducted using synchrotrons in Madison and Argonne in the USA (for info see www.aps.anl.gov/ or www.src.wisc.edu/).

Synchrotron-based techniques make use of synchrotron light, which is generated when electrons are forced to travel in a circular orbit at a speed close to that of light. This very particular light is an extremely powerful tool to understand chemical processes taking place in the soil at molecular level.

Also, the techniques used could assess P speciation and reaction products on single soil particles since their spatial resolution was less than 100 nm (less than 1/10,000 of a mm). This is particularly important since P availability is controlled by very localised processes that occurs in and around P fertilisers.

Phosphorus was found to be highly heterogeneously distributed in soil and, at least in the highly calcareous soil used, was invariably associated with Ca rather than Fe at the nanoscale. The analyses also revealed that in the vicinity of fertiliser granules, P precipitation in the form of insoluble apatite-like compounds is the dominant mechanism responsible for decrease in P lability.

In contrast, when a fluid P fertiliser is applied to soil, less apatite-like compounds tend to form and more P remains in a form similar to that of monoammonium phosphate. This differential response of fluid and granular fertilisers may be linked to the way in which fertiliser P diffuses in soil.

Several studies have demonstrated that P from granular fertilisers remained confined near the granules, whereas P from fluid fertilisers diffused more in calcareous soils. Lower P concentrations in and around fluid fertiliser bands favour adsorption over precipitation, whereas in the vicinity of P fertiliser granules, higher P concentrations could be conducive to precipitation reactions.

The limited diffusion of P from fertilizer granules (which leads to higher P concentration around the granules) may be due to a mass flow of water toward the highly hygroscopic P granule as demonstrated by researchers from CSIRO and the University of Adelaide in a previous issue of Fluid News.

This mass flow of water occurs in a direction opposite to that of dissolved P diffusion, as we have recently demonstrated using an X-ray computed micro-tomography technique. This study was supported by the Australian Synchrotron Research Program and the Victorian Department of Infrastructure and Regional Development.

Liquid Systems (SA)

Liquid Systems (SA) was founded by Peter Burgess in 2002. Peter has a long career spanning 35 years in agriculture, design and engineering, in Australia and California. Peter was initially a general agricultural equipment supplier as well as offering design, consulting and engineering services.

Peter saw an increasing demand for equipment suitable for use with fluid fertiliser and established Liquid Systems (SA). The company designs and builds leading edge fluid fertiliser distribution systems, utilising the latest design, manufacturing and testing processes. Liquid Systems (SA) takes pride in keeping up to date with research and industry information.

Liquid Systems (SA) offers a wide range of built - to - last equipment for handling, transporting and delivery of fluid fertilisers including, pumps, flow control, metering and delivery systems. These systems are designed and constructed to provide farmers with flexibility, durability (life) and reliability. Such is the proven reliability of Liquid Systems (SA) equipment that the company is now the major supplier of fluid equipment to some of the leading machinery manufacturers and suppliers, including Horwood Bagshaw, Morris, and Simplicity Australia.

Equipment is designed for the demanding specifications of fluid fertiliser application (eg high resistance to corrosion, ability to handle high density colloidal fluids like suspensions). The company's equipment design policy is to capitalise on the research and logistical benefits that come from the adoption of fluid technology: increased fertiliser use efficiency and improved yields; flexibility of nutrient application timing and disease control; multi-nutrient synergism; high precision application; and ease of storage and handling.

d-s pump module

Peter Burgess has invested heavily in a comprehensive test facility which enables the examination and monitoring of all aspects of systems under load. This facility is really a Field Simulator and

it replicates what happens on the farm. Many of the components used in Liquid Systems (SA) are unique and are the result of the companies product development program.

The specific requirements of the Australian farmer for low application rates, precise nutrient placement, high resistance to corrosian etc. are unique to fluids and a great deal of attention to product design is necessary to ensure that these requirements are met. The test facility has been instrumental in the development of current Liquid Systems (SA)'s field equipment.

Liquid Systems (SA) test facility has also been used by fertiliser suppliers, CSBP and Incitec Pivot, Agrichem, and Fertisol to evaluate the physical "ease of use" properties of new products. This analysis plays an important role in product development as farmers demand products that are not only agronomically effective, but also offer logistical and ease of use benefits over granular products.

Liquid Systems has a range of products for the application of liquid fertiliser via furrow banding. These systems are designed to be fitted to existing seeding and tillage equipment. They are compatible with the latest electronic control systems.

These include single, dual and triple liquid injection systems. These new systems allow for one pass seeding and nutrient application with tremendous flexibility and significant cost savings.

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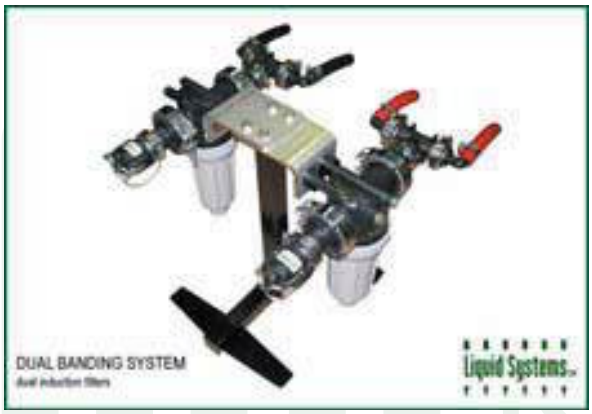

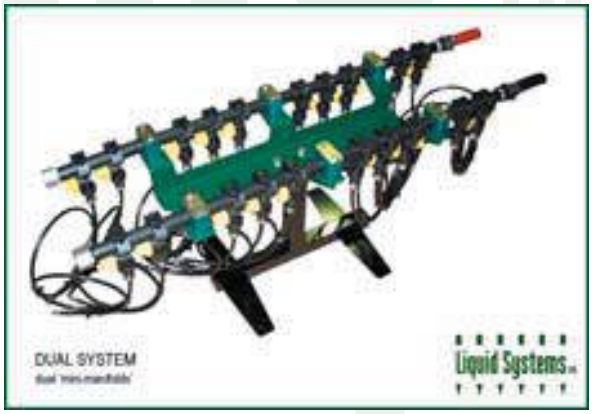

Your fertiliser - is it worth it?

Bob Holloway, Senior Research Officer,
Minnipa Agricultural Centre

Farmers can have confidence that fluid fertiliser use on the grey calcareous soil of the Eyre Peninsula will produce economic benefits. This is particularly true as we have seen a narrowing of the price gap between fluid and granular fertilisers.

Fertiliser costs often make up one third of the variable costs of cropping. Is there any way of knowing whether or not fertiliser is paying its way?

Yes, but it requires good reliable information on how fertiliser application is related to yield over a range of application rates. The only way to get this information in one hit is to do a "rate response" trial, using increasing rates of fertiliser so that the response of the crop to the fertiliser can be accurately measured. We have done many rate response trials over the past nine years.

Knowing the cost of the fertiliser and the value of the yield response, you can relate the cost of the fertiliser to the extra income earned from it. As the rate of fertiliser applied increases, the yield response will slow down until there is no further increase and the fertiliser starts to cost more than it earns rendering it uneconomical.

On Upper Eyre Peninsula, the major soil type used for cropping is the grey highly calcareous sandy loam that mostly occupies the area between the Eyre Highway and the coast. We have been researching the fertility of this soil for the past 9 years and have found that supplying P to crop plants is a major problem. In the early days, Dr Nigel Wilhelm and Brenton Growden showed that wheat plants on the grey soil were still responding to 100 kg P/ha applied as granular superphosphate.

We found that fluid fertilisers are usually 3 to 5 times more effective at supplying P on the grey calcareous soils than alternatives like MAP and DAP. They are also more effective at supplying micronutrients. We also discovered that there are multi-nutrient deficiencies on these soils and the best results occurred using multi-nutrient fluids with P, N and Zn, and preferably also Mn and Cu.

Once a response curve is obtained, it is possible to measure how each fertiliser performs economically by plotting the cost of the fertiliser against the income earned. When the income line is above the cost line the fertiliser is profitable.

Thinking about the 2006 season, and using a typical response curve obtained from Port Kenny last year, we compared the economic performance of the two kinds of fertiliser. The granular fertiliser was 17:19 Zn 2.5 (Price $515/tonne delivered) and the fluid fertiliser was a phosphoric acid solution containing urea and zinc sulphate. The 2006 price for phosphoric acid is $850/tonne delivered. This price has been "locked in" for a few months now by several farmers using fluid fertiliser on the Upper EP. In addition to this, we added the price of the urea and zinc sulphate required and compared the two fertilisers at the same rates of P, N and Zn application. The price of wheat was assumed to be a dismally low $135/tonne, net of compulsory levies and charges. The results are shown in Figure 1.

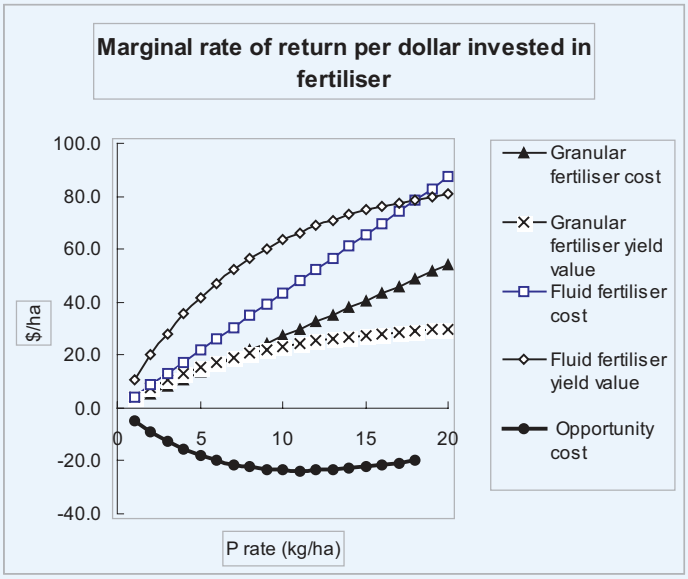

Figure 1. Marginal rates of return for fluid and granular fertiliser based on wheat response curves from Port Kenny 2005.

It can be seen that the rate of return to granular fertiliser is only marginally above the cost between 1 and 7.5 kg P/ha. Above 7.5 kg P/ha, the cost of the fertiliser is more than the wheat income. The gap between income and cost would be improved by a higher wheat price but in the current situation it is worryingly low. In this example, the fluid fertiliser has the capacity to maintain a reasonable return rate on fertiliser investment. Figure 1 also shows an opportunity return which is lost if granular fertiliser is used instead of fluid.

As a relatively new innovation on Eyre Peninsula, fluid fertilisers have struggled to enter the market. However, at least on the grey calcareous soils, there are sound economic reasons for using them, particularly if the price differential with granular continues to improve.

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