Fluid News

Seeding equipment modified for fluid fertiliser injection

Farmer profile >

Andrew Polkinghorne
Warramboo

Lock farmer Andrew Polkinghorne has been so impressed with the results of fluid fertiliser thus far, that he will not go back to granular phosphate.

Andrew has grown wheat, barley and peas at his property since the late 70s. He switched to fluid fertiliser to increase his yield – wanting that to translate to his net profits.

Phosphorus availability is a major factor limiting crop production in the grey calcareous soils like those on Andrew's farm. Recent field trials showed fluid fertilisers may provide a useful alternative to granular fertiliser products, and it was this relevant research, which convinced Andrew to take the leap of faith and try liquid phosphorus.

"We have gone into fluid fertilisers specifically looking at a yield increase we would get out of it and that should translate straight into increased profitability," he said.

And the results so far look promising. "It would appear, although we haven't harvested any crops yet, our crops have benefited significantly," Andrew said.

He added another perceived benefit was the 'evening up of the yield across the paddocks', which coupled with an early vigor helped prevent wind erosion this year.

"It has meant the crops can compete with weeds efficiently and cover the soil quickly – which is very significant when we have just come out of a drought".

Andrew is principally using a Fertisol(R) product which is phosphoric acid based and he mixed in ammonium-nitrate and trace elements. He has also used an ammonium polyphosphate which performed well, to which he added trace elements. He added a 7000L tanker to his 13.5m seeder bar and 9.5L triple bin air seeder to apply the fertiliser. **cont p 2**

From the editor

Fluid News, funded by GRDC, has been developed in recognition of the growing interest in the use of fluid fertiliser on highly calcareous soils and the potential benefits to growers.

We want Fluid News to become your forum to raise your issues and concerns with respect to fluid fertiliser use.

Tell us your experience with Fluid Fertilisers and share any tips. We want your input and for you to steer this newsletter – request the communication and information you want from researchers.

Contact Jim Kelly:
jkelly@arris.com.au
(08) 8303 7247
0427 821 625 for feedback.

GRDC
Project UA 00023

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It has cost Andrew about $60,000 in the switch to liquid phosphorus, including the purchase of tanks to store the fertiliser on site, tanks to cart the liquid to the paddocks,a truck to pull the tanks, the tanker to go behind his air seeder and the modifications to the seeder for distribution.

"It has been relatively easy to get equipment with a bit of planning.
"Having done it once, we now have the confidence to continue with it. Now we have done it and seen the results we are pretty happy," he said.

Andrew sees a bright future for fluid fertilisers, but to ensure that future he has called for continuing research and communication to growers.

Andrew started using the phosphoric acid based Fertisol(R) product, mixing in nitrate and trace elements, this season. While it was 'relatively straightforward' for him, it wasn't all smooth sailing, with Andrew having to learn through trial and error – especially with regards to equipment.

Andrew dispelled the common fear about toxicity, saying he found 'it (surprisingly) good to handle - even from an OH&S point of view, there was no particular issue'.

He has had little problem with supply, but he advised other farmers to follow his lead and store the fertiliser on site.

"We had over half our requirement in storage tanks," he said.
"It's important to have a reasonable amount of storage on farm because the stuff has to be delivered from Adelaide – you need to have a large percentage of the stuff on site".

Andrew believes further research should be conducted into mixing furrow-fungicides with the fluids, saying there is potential to grow more consistent continuous cereal crops as opposed to rotation.

"There should be more work in getting trace elements into polyphosphoric fertilisers which are superior products in other ways," he said.

Tyne assembly showing fluid fertiliser injection tube.

Andrew also called for seed funding to establish a local fluid fertiliser manufacturer, saying it was almost a catch 22 situation – there is no volume produced because it is not cheap, and it is not cheap because there is no volume.

The decision to move to fluid fertiliser has been much easier for Andrew than most. Some of the recent trials had been conducted on his property . He knew his calcareous soils had shown excellent results with liquid phosphorus.

"I think other farmers have an issue whether it will work with their soil types.

"[Researchers] need to develop a quick simple test to indicate what is the level of response...

"Farmers aren't sure whether they will get the response they want," he said.

Andrew will continue to use granular nitrate, saying it is far superior, but he 'will not shift back to granular phosphorus unless the economics change'.

In brief

- Grey calcareous soils
- Uses a zerotil farming system with full trash retention
- Principally uses a Fertisol(R) phosphoric acid based product.
- Put on a total of 120L/ha including water

Eyre Peninsula studies

Researchers into fluid fertilisers have been conducting trials in South Australia since 1993, with mixed results.

Studies originated on the Eyre Peninsula on the grey, highly calcareous soils. Wheat yields on these areas had traditionally been low in productivity, remaining static for more than 40 years. Applications of nutrients via a Paraplow(R) gave large increases in grain yield of wheat eg 1400kg/ha to 3200kg/ha. However, researchers concluded the use of the Paraplow(R) on large areas of stony soil was impractical.

In 1997, Bob Holloway and Dot Brace began looking at more practical ways of getting nutrients into these soils. Working concurrently, Nigel Wilhelm and Brenton Growden conducted rate response experiments with granular P at several sites on upper Eyre Peninsula. Results indicated a very slow response to granular P, even at Colwell levels of 60mg P/kg soil. Plants were still slowly responding through increasing grain yield after the addition of 100kg P/ha – an impossibly high rate for economical production. Their conclusion was that a more efficient source of P was needed on the soils for economical cereal production.

Bob and Dot's 1998 data indicated fluid sources of P were a more efficient source than MAP. However, further investigation was needed to quantify the efficiencies of the two fertilisers and expand on the range of nutrients to nitrogen and micronutrients. Improvements also needed to be made in terms of placement and formulation of products. More information was needed on placement effects, the effects of dilution with water and the effects of nutrient combinations.

The fluid delivery system was improved in 1999 and all fertilisers were placed 3cm below the seed. Results showed at Miltaburra, at low rates of P, fluid P could be 15 times more effective than granular (eg 4kg applied as TG-MAP produced the same grain yield as 60kg P/ha as MAP).

At higher rates, the relative effectiveness of fluid was about ten times greater than granular P. At Yandra, fluid was four times more effective – a stunning result, according to SARDI researcher Dr Bob Holloway.

Early fieldwork was supported by laboratory and glasshouse experiments conducted with P by CSIRO Land and Water's Dr Isabelle Bertrand and Dr Mike McLaughlin.

Recent picture

Recently, the general picture gained from field experimentation has become much more complex. Many of the results indicate wide variations in response from site-to-site and year-to-year. However, the responses to fluids on calcareous soils have been consistent enough across a wide area and range of seasons to justify adoption by farmers even at a considerable price differential. Fine tuning of formulations and application systems locally will need to occur before general recommendations can be made.

A GRDC research project is currently underway, using a three pronged attack.

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One group is concentrating on explaining the chemistry of how fluid and granular phosphorus fertilisers behave in the soil and form reaction products.

Effective placement is critical in fertiliser performance, so field and lab investigations are being conducted into factors which affect placement – pressure, dilution rate, row spacing, depth of placement, evenness of applications, fluid formulations, configuration of delivery systems, materials and timing . A key component is investigation of the Root Zone Injector principle in achieving deep placement of nutrients through high-pressure injection of fluids. Residual effects are also critical. Researchers have just established a significant relationship between the forms of P applied in the previous year and dry matter production of wheat shoots on a grey, highly calcareous soil.

The other research avenue of the fluid project is to investigate differences in formulation and nutrient interactions, particularly N&P with micronutrients.

Dr Holloway believes there should be further investigations into suspension fertilisers specifically for South Australia, especially with no fluid manufacturing facilities located in this state. All fluids are imported in to SA, leading to a doubling in cost for P or N due to freight costs.

“Given the current state of the fertiliser industry, unless a company is prepared to build a fluid plant in SA, suspensions may be our best alternative,” he said.

Breaking News

EP researchers have picked up the first indication of a better residual response to fluid P than for granular. Wheat grown on last year’s fluid plots without P this year at Tim and Tracey van Loon’s property at Warramboo, produced significantly more shoot weight than on granular plots.

Funding for this latest project came from GRDC, SAGIT and Fluid Fertilizer Foundation. Co-operators are Leon, Marilyn, Carolina and Darren Mudge,Maildaburra;Tim and Tracey van Loon, Warramboo; Keith and Julie Tree, Elliston; Karcultaby Area School; Minnipa Agricultural Centre; SARDI.

RZI trials
Brendan Frischke

SARDI is trialling high pressure as a means of applying fertiliser solutions, as part of the current GRDC funded Fluid Fertiliser project.

A specially manufactured Root Zone Injector was purchased from Canada to conduct the testing. The RZI is a machine that injects liquids directly into the soil using high pressure.

Potential benefits are the ability to apply pre-plant fertilisers without tillage, apply incrop fertilisers directly into the root zone reducing atmospheric losses and reduce the reliance of follow up rain to broaden the window of opportunity for application of nitrogenous fertilisers.

The unique aspect of the RZI is that the output flow is not continuous. A valve system interrupts flow to the nozzles so that the output is pulsed. Pulsing the output reduces the application volume to a more acceptable level and also allows the output to be altered by varying speed and pulsing frequency.

SARDI researcher Brendan Frischke said the remainder of the project would be used to evaluate the effectiveness of fertiliser application using the RZI. Comparisons will be made with existing techniques for supplying the same nutrients in a range of environmental conditions.

“This will enable us to identify whether the RZI has advantages over current methods for targeted fertiliser applications given specific environmental conditions,” Mr Frischke said.

Phosphorus efficiency

Phosphorus availability is a major factor limiting crop production in highly calcareous soils. To improve crop growth, farmers have used large amounts of P fertilisers over many decades.

However, only a small fraction of the P applied with fertilisers is taken up by crops in the year of application, and the effectiveness of any residual P fertiliser declines with time. This is a particular problem in highly P-sorbing soils such as very calcareous or strongly weathered acidic soils.

These soils are important in terms of agricultural production in many areas of the world. For instance, in South Australia, about 40% of the wheat is produced on the Eyre Peninsula, which contains more than a million hectares of calcareous soils. However, the efficiency of P fertilisers in these soils is generally very low because P reacts with Ca forming minerals.

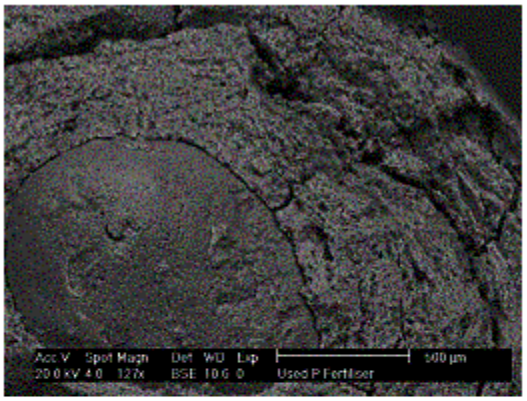
The concentration of available extractable orthophosphate continues to decrease over time in calcareous soils.

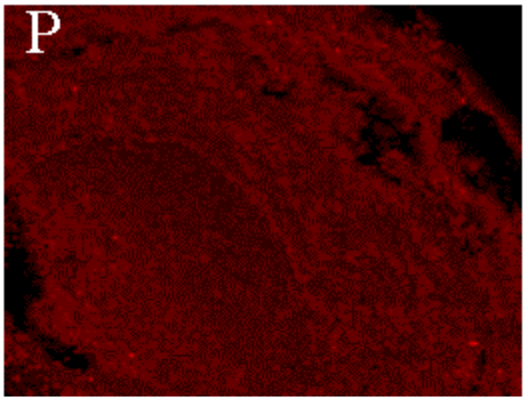
Recent field trials on calcareous soils in southern Australia have shown fluid fertilisers may provide a useful alternative to granular fertiliser products. Fluid sources of P enhance P uptake and yield when compared to granular fertilisers applied at the same rate.

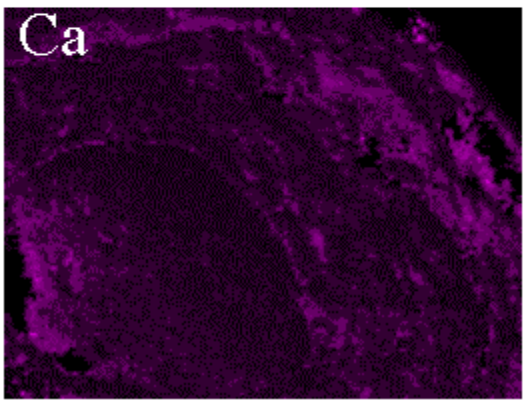
This work, funded by GRDC, SAGIT and the Fluid Fertilizer Foundation, aimed to compare the behaviour of one fluid, TG-MAP, and one granular, MAP, form of P fertiliser in a highly calcareous soil.

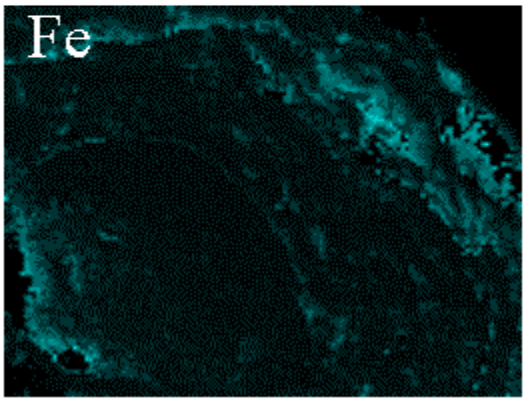
Changes in soil pH, and P diffusion, solubility and lability were determined at different distances from the point of application over five weeks.

Results indicated that P from fluid TG-MAP diffused more and was more available than P supplied as granular MAP.









Picture shows a cross section of a granule after five weeks exposure to soil. The P slide shows that a significant amount of phosphorus remains in the granule potentially unavailable to the crop. Calcium (Ca) and iron (Fe) slides show that calcium and iron are moving from the soil into the granule.

International Studies

Fluid Fertilisers make up a large percentage of the American market. Consequently, there are ongoing studies into the use. The following list is just a sample of what is being undertaken by The Fluid Fertilizer Foundation.

For more details on any of the studies, refer to www.fluidfertilizer.com

§ Use of Fluid Fertilisers in Strip Tillage and No-Tillage Corn Production,
Dr Barney Gordon, Kansas State University.
This project continues the assessment of fluid placement including location of starter bands.

§ Grain and Grazing Responses to Phosphorus Placement Applied to Wheat Pasture in the Texas Rolling Plains,
Dr Don Robinson, Texas, A&M Research and Extension Centre.
This project is establishing the effects of P and P placement (band and broadcast) on wheat forage production and beef gains in a large-scale grazing study.

§ Cropping Systems Effects on Soil Characteristics and Productivity,
Dr Ardell Halvorson, ASDA-ARS.
This study is evaluating the effects of nutrient applications to crop residues on sequestration of carbon in soil organic matter and the effects of those treatments on soil productivity and crop yields.

§ Developing more Effective Starter Fertilisers for Conservation Tillage Production,
Dr John Kovar, USDA-ARS.
With the interest in, and importance of the use of, starter fertilisers in conservation tillage production systems, this research complements earlier investigations in evaluating higher rates of N in starter fertilisers placed in a 2x2 configuration, in a 2x0 location of surface banded over the row. The study is also investigating the effects of starter fertiliser formulation on fertiliser P mobility in the soil.

§ Developing Effective Starter Fertilisers for Conservation Tillage Systems,
Mr Ron Mulford, University of Maryland.
This project is a continuation of earlier work which has indicated a high degree of flexibility in fluid starter fertiliser placement for conservation tillage corn on Coastal Plain soils in eastern Maryland. The study is also determining the importance of increased levels of ammonium nitrogen in starter fertilisers on corn yields on high P testing soils under conservation tillage systems.

§ Optimising Rate and Source of Nitrogen Fertiliser in No-Till Wheat,
Dr Cindy Grant, Agriculture and Agri-Food, Canada.
This study is designed to evaluate the effects of increasing rates of side-banded UAN and urea with and without Agrotain on seedling emergence, biomass yield and grain yield of no-till spring wheat.

§ Spring and Sidedress Fluid Fertiliser Programs as Alternatives to Traditional Fall N Application for Corn,
Dr Gyles Randall, University of Minnesota.
The objectives of this study are to determine the effect of planting time and sidedress applications of UAN as alternatives to traditional single fall and spring preplant treatment for corn production after soybeans for two distinctive tillage systems.

Victorian results following better season

Victorian researchers are hoping for better results from their GRDC funded Fluid Fertiliser trials this year, after drought virtually wiped out their efforts last year.

The Victorian Dept of Primary Industries ran three trial sites – at Dooen on cracking clay soils, Birchip in Southern Mallee calcareous soils and at Walpeup.

Senior Agronomist Dr Roger Armstrong said early trial results suggested there was no difference between fluid and granular P sources on the cracking clay.

"However, there was some highly significant differences with fluid performing much better at Birchip and Walpeup," he said.

The latter two sites have a similar soil makeup to the grey calcareous soils on the Eyre Peninsula where fluid P has shown great success.

"We hope to start harvesting the Mallee Trials during the next few weeks to see whether they transferred into an increased yield," Dr Armstrong said.

With limited success in the trials last year, very few Victorian growers are using fluid P at this stage.

"There is a huge amount of interest. I think the growers are taking the line of wait and see results first," he said.

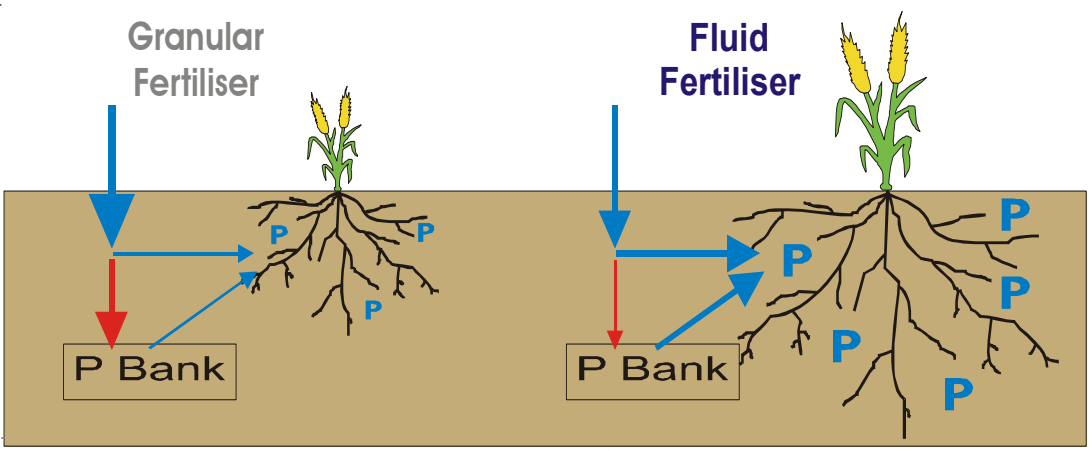
"Victoria is about five years behind SA [in fluid fertiliser research].
"We do most of our cropping on alkaline soils which is a small but significant difference with those located on the Eyre Peninsula. They are not as calcareous".

Glasshouse trials, partly funded by SAGIT, were also conducted over 30 soils spread across Victoria and SA.

Preliminary evidence also suggests that fluid sources of P are more efficient than the traditional granular form on a wide range of alkaline soils found in Victoria. The trials indicated that fluid fertilisers such as APP and Phosphoric Acid produced greater dry matter yields than granular forms such as Triple P in sodosols and calcarosols collected from the Victorian Mallee.

Researchers have also discovered that not only do fluid fertilisers minimise the amount of P that is deposited into this P bank, but that applying fluid fertilisers may actually help crops to mobilise valuable P from this pool.

"These results suggest that at last there is a commercially feasible way of helping growers to access this P and this reduces the amounts of fertiliser they apply,"
Dr Armstrong said.



This graphic shows a schematic representation of the increased availability of phosphorus applied with fluid fertilisers in high pH calcareous soils.

International recognition

Eyre Peninsula's fluid fertiliser trials have received international recognition, following publication of results in Fluid Journal – the official journal of the Fluid Fertilizer Foundation.

Operating funds provided by The Fertilizer Foundation enabled wheat trials to be conducted at Miltaburra, Emerald Rise and Yandra on the Upper Eyre Peninsula.

Phosphorus funds secured

A joint research team from Dept of Primary Industries and CSIRO Land and Water will further investigate how different forms of phosphorus react with soil particles early next year.

Dr Roger Armstrong, Dr Enzo Lombi, Dr Mike McLaughlin and Dr Kirk Scheckel secured funds from the Australian Synchrotron Research Program. This project was also supported by CSBP (Dr Stephen Loss).

Phosphorus is one of the most difficult nutrients to obtain from the soil and often limits agricultural production. Millions of tonnes of phosphorus fertilisers are applied to soils each year, but a high proportion of this P is rapidly converted to insoluble phosphates which plants virtually cannot access.

Dr Lombi said the team had applied for research funds to help increase knowledge about this important element, with future research expanded from calcareous soils.

Researchers aim to investigate how different forms of P react with different soil particles at the molecular level. Synchrotron-based techniques provide the most powerful tool available to obtain this information. Apart from helping agriculture, the project's findings will also help the fertiliser industry manufacture and supply more efficient and competitive products.

Contacts

CSIRO Land and Water
PMB 2
URRBRAE
South Australia 6064

Dr Mike McLaughlin
Research Director
Ph: +61 8 8303 8433
Fax: +61 8 8303 8565
Email: mike.mclaughiln@csiro.au

Dr Enzo Lombi
Research Scientist
Ph: +61 8 8303 8476
Fax: +61 8 8303 8565
Email: Enzo.Lombi@csiro.au

Department of Primary Industries: Victoria
PMB 260
HORSHAM
Vic 3401.

Dr Roger Armstrong
Senior Agronomist
Ph: +61 3 5362 2336
Fax: +61 3 5362 2187
Email: roger.armstrong@dpi.vic.gov.au

South Australian Research and Development Institute (SARDI)
Minnipa Agriculture Centre
PO Box 31
MINNIPA
SA 5654

Dr Bob Holloway
Principle Research Officer and Officer in Charge
Ph: +61 8 8680 6203
Fax: + 61 8 8680 5020
Email: holloway.bob@saugov.sa.gov.au

Brendan Fischke
Research Officer
Ph: +61 8 8680 6206
Fax: + 61 8 8680 5020
Email: fischke.brendan@saugov.sa.gov.au

Edited and designed by Arris Pty Ltd

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ACN. 092 739 574