QUINSPREAD
TECHNOLOGIES LIMITED

THE FULL FACTS ON NITROGEN LOSSES

AN INTERVIEW WITH DR BERT F. QUIN

MANAGING DIRECTOR - QUIN ENVIRONMENTALS (NZ) LTD

Dr Bert Quin's career includes 15 years in fertiliser and environment research with the New Zealand Ministry of Agriculture's Research Division (the last 3 as Chief Scientist for Soil Fertility research), and 17 years as Joint Managing Director and General Manager of the company he founded with Grant McComb in 1989, Quinphos Fertilisers (NZ) Ltd (subsequently Summit-Quinphos (NZ) Ltd).

Since selling his shareholding and standing down as GM of SQ in 2005, Dr Quin has continued his work in developing new environmentally-protective fertilisers and practices in New Zealand, Australia and Vietnam, through his private consultancy companies Quin Environmentals (NZ) Ltd & Quin Environmentals Pty Ltd.

Quinspread Technologies Limited is a joint venture between Dr Quin, Grant McComb and the central North Island (New Zealand) fertiliser groundspreading company N.T. Wealleans Ltd. Quinspread commenced commercial operation in August 2007.

Q: WHY ALL THE FUSS OVER NITROGEN?

A: Nitrogen (N) is a notoriously "leaky" nutrient in developed agriculture. It escapes into the environment much more easily than most other nutrients, with adverse affects on water quality and global warming.

Q: DO NITROGEN FERTILISERS SUCH AS UREA MAKE THE PROBLEM WORSE?

A: Yes, directly and indirectly. At normal rates of application to a dairy farm, the main direct losses of nitrogen are as ammonia volatilisation (5% – 40% of the applied N depending on conditions), leaching of nitrate (5% – 30% depending on conditions), as well as the emission of the nitrous oxide greenhouse gas (1% - 10%). Typically less than 50% of the area applied gets to be taken up by the plant. This why dairy farmers expect only 10 -15kg of extra dry matter for every kilogram of fertiliser N applied, when 30 plus should be the norm.

Q: WHAT DID YOU MEAN WHEN YOU SAID "DIRECTLY" AND "INDIRECTLY"?

A: The 50% direct loss of applied N is bad enough, but in dairy farming there are additional large losses of N from cow urine. Over 80% of the total N taken up by dairy pastures is excreted in the urine, mainly in the form of urea. The rate of N application in the urine patches themselves is typically 650 – 1000Kg N/ha. The pasture typically recovers only 20 – 25% of this before it is lost, mainly as leached nitrate. This can easily give rise to losses of over 100kg/ha.

Q: BUT HOW CAN THIS BE BLAMED ON FERTILISER N?

A: It cannot be, as long as the farm is running a grass-clover system with no fertiliser N input and only feed with low nitrogen concentration, and grown without N fertiliser, brought in. Under these systems, losses from urine patches are still a problem, but losses are reasonably low per hectare.

However, once you rely on fertiliser to boost production to levels that are reasonably profitable for the farmer, you get the direct losses of nitrogen from the urea through leaching, emissions and ammonia volatilisation. But we also need to keep in mind that the much higher production per hectare achieved results in much higher levels of nitrogen-rich grass being eaten, returning much higher levels of N to the environment in urine.

Q: WHAT SORT OF THINGS TO WE NEED TO DO TO REDUCE N LOSSES?

A: We must minimise as many leakages of N from the system as possible – in other words "tighten the N cycle". There are three major components to doing this:

Use the most agronomically efficient form of N possible, combined with the appropriate inhibitors. But it must be profitable for the farmer to use in its own right. If the N fertiliser and/or inhibitor product is not profitable in its own right, we might as well go back to a purely grass-clover system.

Reduce the concentration of N, and therefore the amount excreted in each urination, by budgeting for daily levels of N in the pasture and brought-in feed that are as close as possible to the nutritional requirements of the cow. It will take some years for farmers to become confident about doing this, but it is important.

Introduce systems, products or devices that allow or lead to more recovery of the N excreted in the urine. These include winter feed pads, and possible devices in or on the cow designed to incorporate inhibitors into the urine flow.

Q: ARE ANY OTHER FORMS OF NITROGEN FERTILISER MORE EFFICIENT THAN UREA, AND THEREFORE BETTER FOR THE ENVIRONMENT?

A: Generally, Yes. Calcium ammonium nitrate (CAN) is typically up to 30% more efficient than urea. But it is considerably more expensive than urea, resulting in no net advantage to the farmer in most cases. In any case its availability for use is now severely restricted in most countries because of its ease of use in explosives. Sulphate of ammonia is also more efficient than urea but is also more expensive, unless the sulphur content (24%) is needed. This is unlikely on most New Zealand dairy farms, as their soils are generally already overloaded with sulphate-sulphur from superphosphate. As this excess sulphate is leached, it takes with it valuable cations.

Q: SO CAN YOU MAKE UREA MORE EFFICIENT?

A: You most certainly can! By treating the urea with the urease inhibitor (NBPT) – trade name Agrotain - which minimisies ammonia volatilisation as well as having the indirect secondary benefit of reducing nitrate leaching. The product is sold in New Zealand by Summit – Quinphos and Ballance under the SustaiN brand name. It is sold in Eastern Australia by Incitec Pivot Ltd as "Urea Green" and in Tasmania by as SustaiN by Quin Environmentals Pty Ltd. For a typical 20% premium SustaiN (in granular form) delivers an average of 50% more dry matter response than urea in single applications, and 34% on average to date where urea or SustaiN are being applied frequently at 25-50kgN/ha (eg, after every or every second grazing). So it is extremely cost-effective for farmers to use.

Q: OK, THAT'S SUSTAIN. WHAT ARE BALLANCE'S DCN AND RAVENSDOWN'S ECO-N THEN?

A: This is a more specific approach to the problem of nitrogen losses, one that is targeted more at reducing N losses – leaching and nitrous oxide emissions - from urine patches. DCn is about 25% DCD co-granulated with zeolite clay to make it easily spreadable from conventional groundspreading trucks. DCD, and therefore DCn, is a nitrogen fertiliser in its own right, but a high cost ($800/tonne) and low N content one.

Like DCn, eco-N is targeted at reducing nitrate leaching and nitrous oxide emissions from urine patches. The difference is that eco-N is a suspension of DCD (about 65%) in water (about 35%) that is applied through specialised tankers via spray booms. Ravensdown recommend two applications per year, in May and August typically, at an applied cost of about $63/ha each, or $126/ha annually. Ballance's DCn is closer to $50 per application.

Q: SO, PUTTING TO ONE SIDE THE ENVIRONMENTAL BENEFITS, ARE ECO-N AND DCN COST-EFFECTIVE FOR THE FARMER TO USE?

A: In my assessment, probably not, in the majority of cases. This could change if the Government proceeds with proposals to subsidise the use of nitrification inhibitors such as DCD, financed by either a tax on urea, or, preferably and far more fairly in my view, by a tax on the precious but underpriced natural gas used to make urea at the Kapuni urea plant.

Q: BUT HANG ON, RAVENDOWN ARE CLAIMING THAT ECO-N NOT ONLY REDUCES LOSSES, BUT INCREASES PASTURE PRODUCTION AT ONLY HALF THE COST OF UREA. IS THIS TRUE OR NOT?

A: Within a very narrow set of parameters, it possibly is. However, in an overall farming sense, I would say definitely not. It is true that both eco-N and DCn can give economic responses at the recommended rates of application. However, and this is the vital point, the total response obtainable using these products at the recommended rates, has never to my knowledge exceeeded two tonnes of extra DM/ha per annum in any circumstances, and under one tonne in most.

In fact, if you look closely at the pasture production graphs in Ravensdown's latest eco-N advertisement (back cover, Straight Furrow, 17/7/07), you will see that even in the time periods selected for presentation, the maximum increase in pasture production obtained in the two North Island trials for which any data are presented are about 1.9 tonne/ha at Pahiatua and a mere 0.6 tonne/ha in Northland.

Even more concerning is the fact that no pasture production data whatsoever is presented for any of the trials conducted in the main North Island dairying areas, where AgResearch trials have indicated little or no response. The soil types are totally different to the shallow, free-draining soils used in most of the South Island studies, where larger reponses have been measured, sometimes with very frequent applications of eco-N.

We must keep in mind that most of benefit from eco-N and DCn comes from their ability to increase the recovery of the N deposited recently in urine. But at any one time in the period of effectiveness of a particular application of DCn or eco-N, recent and therefore "treatable" urine patches are unlikely to cover more than 5% to 10% of the pasture!

For these reasons, neither Ravensdown or Ballance suggest that the levels of pasture production currently being obtained with the typical annual application on dairy farms of 150-300 kg N/ha as urea can be attained by replacing this urea with only 2 small applications per annum of eco-N or DCn. Implicitly, they are saying "use urea AND eco-N or DCn".

Q: SO WHAT DO YOU THINK IS THE WAY FORWARD?

A: I think that rather than using urea AND separate, very expensive, applications of eco-N or DCn, we should change to using SustaiN-type products incorporating inhibitors – Agrotain and DCD as required – so that not only is the urea itself made as efficient as possible, but there is adequate inhibitor present in the product to control N losses of any recent urine patches the product lands on during spreading.

Furthermore, helicopter fine particle technology, and emerging technology for the groundspreading of FPA suspensions and fluidised fertilisers, have the ability to further increase N response efficiencies and reduce losses.

Q. CAN YOU EXPLAIN THIS A BIT MORE?

A. OK. Firstly, urea is much more agronomically and cost-efficient, and environmentally much safer, when treated with the urease inhibitor NBPT, as in SustaiN. Applying this as a fluid of fine particles in water increases agronomic efficiency much more again. But we also need to greatly reduce losses of the greenhouse gas nitrous oxide, especially from urine patches. If you add the appropriate amount of a nitrification inhibitor such as DCD as well, you accomplish this. A fluidised fertiliser application deposits literally hundred of fine fertiliser and inhibitor particles on each urine patch, as opposed to hitting or missing – in the real world - with a few granules. And, by having all this incorporated with the N fertiliser, you minimise application costs.

Q. DOES THE TECHNOLOGY EXIST TO DO THIS WITH GROUNDSPREADING TRUCKS?

A. As you know, specialised spray-booms already exist to allow pre-fluidised products to be applied from helicopters and fixed-wing aircraft. This is an expensive operation, especially on small-area applications on dairy farms, because of the need to bring a support truck and manpower to the farm as well as the aircraft. Likewise, specialised tanker-trucks with booms are require separate facilities for fluidising the product. Generally, both approaches require at least 30-40% by weight of water to be added.

But now, Quinspread Technologies Limited, working with N.T. Wealleans engineering division, have pioneered a totally new approach, in which groundspreading trucks are fitted with purpose-built hoppers and twin "Fluidator" units which grind, fluidise with a small proportion (typically 10% or less) of water, add any inhibitors or performance additives as required, and spread, all in one process. The driver just loads with conventional fertiliser – urea, SustaiN, RPR, even lime – and spreads it. No fuss, no bother! And it will spread dry fertliser as well, if required.

The first unit was built just in time for the Field Days, and has just completed spreading optimisation trials.

Q. PUT SIMPLY, WHAT ARE THE MAJOR BENEFITS OF THIS TECHOLOGY?

A. (1) Regarding nitrogen, farmers will achieve the same response with on average only half the amount of N required as granular urea. Less cost per kg DM, and much, much lower losses of N to the environment.

(2) Regarding lime, virtually no dust, without the cost of using expensive granulated products.

(3) Regarding phosphate, much lower risk of P run-off, and minimisation of dust.

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