IMPROVING THE EFFICIENCY OF FERTILISER UREA ON PASTURE WITH ONEsystem®

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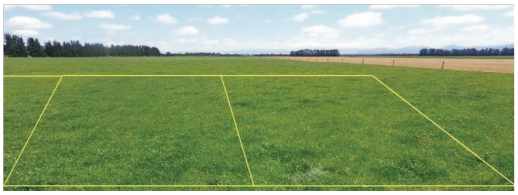
(Presented at Massey University FLRC Conference Feb 10-12 2015)

INTRODUCTION AND TRIAL DESIGN

Control pasture (no N applied). Note strong growth from the urine patches.

Maurice Gray pre-checks fertiliser application rates.

Dr Allan Gillingham takes notes while Maurice Gray prepares to apply treatments.



30kgN/ha as ONEsystem® (left) and granular urea (right). Note how the urine patches have become almost unnoticable with ONEsystem®.

Introduction

- Granular urea is by far the most widely used nitrogen (N) fertiliser in New Zealand, with an estimated 750,000 tonnes (345,000 tonnes N) applied annually, most of which goes on dairy farms. Approximately 50% each appears spread by contractors and farm owners/sharemilkers.
- The main reason many farmers choose to spread their own urea is not so much to save the spreading cost, but rather the importance they place on getting the urea applied at the best time to optimise pasture growth, generally 1-3 days after grazing.
- Given the importance many farmers place on optimising the pasture response to urea, there has been surprisingly few attempts to improve its performance by the main fertiliser manufacturers and suppliers.

Trail Design

- This poster presents results from one of two replicated field trials conducted under grazing; under irrigation in mid-Canterbury, on Lismore stony silt loam, a Yellow Grey Earth classified as an Ustrechrept under USDA Taxonomy.
- The trial compared 3 rates of granular urea with a new process – ONEsystem® - developed by Dr B. Quin and S. Spilsbury over the last 2 years in Gippsland, Victoria and in New Zealand. The system uses prilled (micro-granule) urea, which is treated with the urease inhibitor nbpt and passes through a fine water spray during application.
- A nil-N control and 3 rates of each fertiliser (14, 28 and 42 kg N/ha) with 4 replicates were applied to large plots immediately after grazing on four occasions during spring/early summer 2014. Pasture yields before and after grazing were measured on individual plots using a rising platemetre, which was calibrated against weighed dry matter (DM) on several occasions.

RESULTS

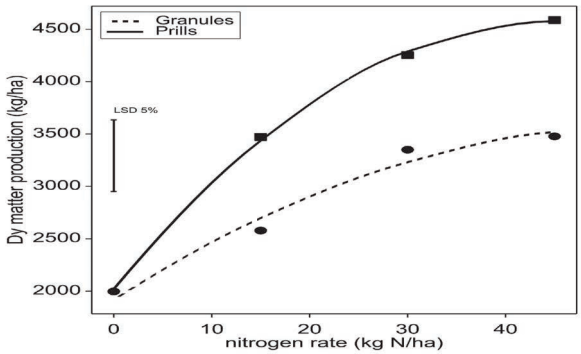


Figure 1. Total pasture dry matter growth responses (greater than control) in mid-Canterbury from increasing rates of N applied as either granules or prills. The fine dotted lines between the fitted quadratic curves show the levels of applied nitrogen for granules (30 kg/ha) and prills (12.5 kg/ha) needed to give a dry matter production response of 3230 kg/ha.

Close-up of pasture with ONEsystem® prills

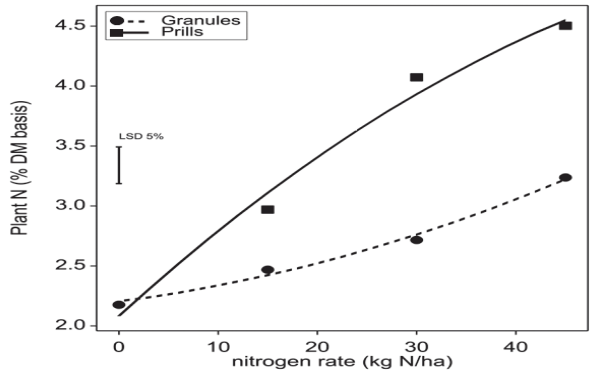


Figure 2. Plant nitrogen % averaged from samples taken on 10 November and 2 December 2014 in mid-Canterbury from increasing rates of N applied as either granules or prills. The curves are the fitted quadratics for each type including the control which is treated as belonging to both curves.

Interpretation of DM and %N results

The much greater efficiency of ONEsystem® prills comes from the following-

- Far better coverage-500 prills/m2 compared to 45 granules/m2 at 30 kgN/ha applied, meaning every plant (400/m2) gets a much more even supply of N (see above)
- A degree of foliar uptake (estimated at 10 kgN/ha), as prills dissolve in situ on plant leaves
- Greatly reduced ammonia volatilisation
- Reduced nitrate leaching and nitrous oxide
- These factors are being investigated separately
- The results above are not unique to this trial and conditions
- However, indications of a much lower plateau in DM with granular urea are more pronounced at this site

The increased herbage N% demonstrates that N recovery with ONEsystem® was even greater than that indicated by DM increase alone. At this site, there was little clover and soil N supply was very yield-limiting; control (nil N) pasture N levels were below optimum.

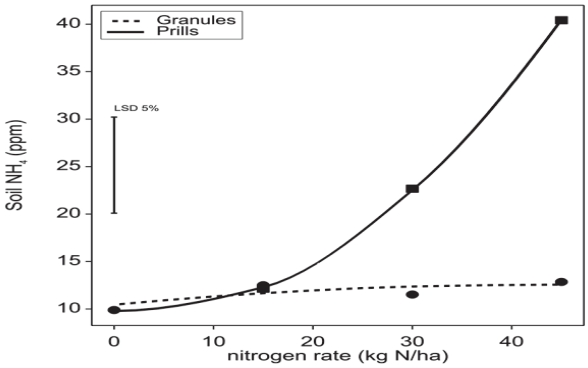


Figure 3. Soil NH4 (ppm) averaged from samples taken on 10 November and 2 December 2014 in mid-Canterbury from increasing rates of N applied as either granules or prills. The curves are the fitted quadratics for each type including the control which is treated as belonging to both curves.

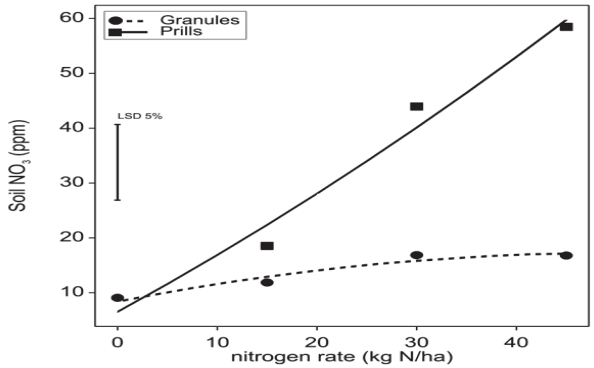


Figure 4. Soil NO3 (ppm) averaged from samples taken on 10 November and 2 December 2014 in mid-Canterbury from increasing rates of N applied as either granules or prills. The curves are the fitted quadratics for each type including the control which is treated as belonging to both curves.

Interpretation of soil mineral N data

- Mineral N levels remaining in the topsoil were considerably higher, at the two highest rates of N applied-with ONEsystem® prills than with granular urea
- As much greater pasture N recovery took place with the ONEsystem® prills, this indicates that much greater losses from the topsoil, either through nitrate leaching or gaseous emissions, had occurred with granular urea
- As farm irrigation rotations were carefully controlled so as not to exceed water-holding capacity, this indicates that ammonia volatilisation was the greatest loss mechanism from granules
- Higher levels of soil nitrate- N remained after high rates of applied N as ONEsystem®. At the end of the 4 applications/4 rotations this would certainly result in higher residual pasture growth, but with a risk of nitrate leaching if a very heavy rainfall event occurred. Therefore, individual applications of no more than 30 kgN/ha as ONEsystem® are recommended

WHY SO GOOD?

ONEsystem®– eliminating N losses and ineffciencies with granular urea

Granular urea loss/inefficiency	ONEsystem® answer
Many plants receive no N at all - insufficient number of particles	Use of prills mean 10 times more particles – N supplied to every single plant
Little if any foliar uptake, missing out on this very efficient mode of N utilisation by the plant	The use of prills, wetted during spreading, ensures that the product dissolves on the leaf
Very susceptible to ammonia loss	Urease inhibitor minimises this
Nitrate leaching is a big problem - too much is produced too soon relative to plant N uptake	Faster, more even plant uptake via foliar uptake and better distribution of small particles

ONEsystem®– eliminating drawbacks with other efficiency alternatives

Drawbacks of alternative	ONEsystem® answer
High cost of product (most coated granular products)	Cost of prills similar to granules; application costs competitive
Lack of reliable benefit (granular urea, 'biologicallytreated' urea)	Wetted prills optimise foliar uptake, nbpt minimises NH3 volatilisation
Scorching-excessive instantaneous leaf uptake (liquid or fluidised urea)	Time required for wetted prills to dissolve slows foliar uptake enough
Striping due to uneven spread and fines falling behind truck (granular)	Prills give far more even coverage, avoiding striping
Difficulty in getting product when Farmer needs it (contractors)	Focused ONEsystem® contractors synchronise with farm rotation

CONCLUSIONS

ONE system™

Optimised Nitrogen Efficiency

The results from this field trial under grazing have demonstrated that -

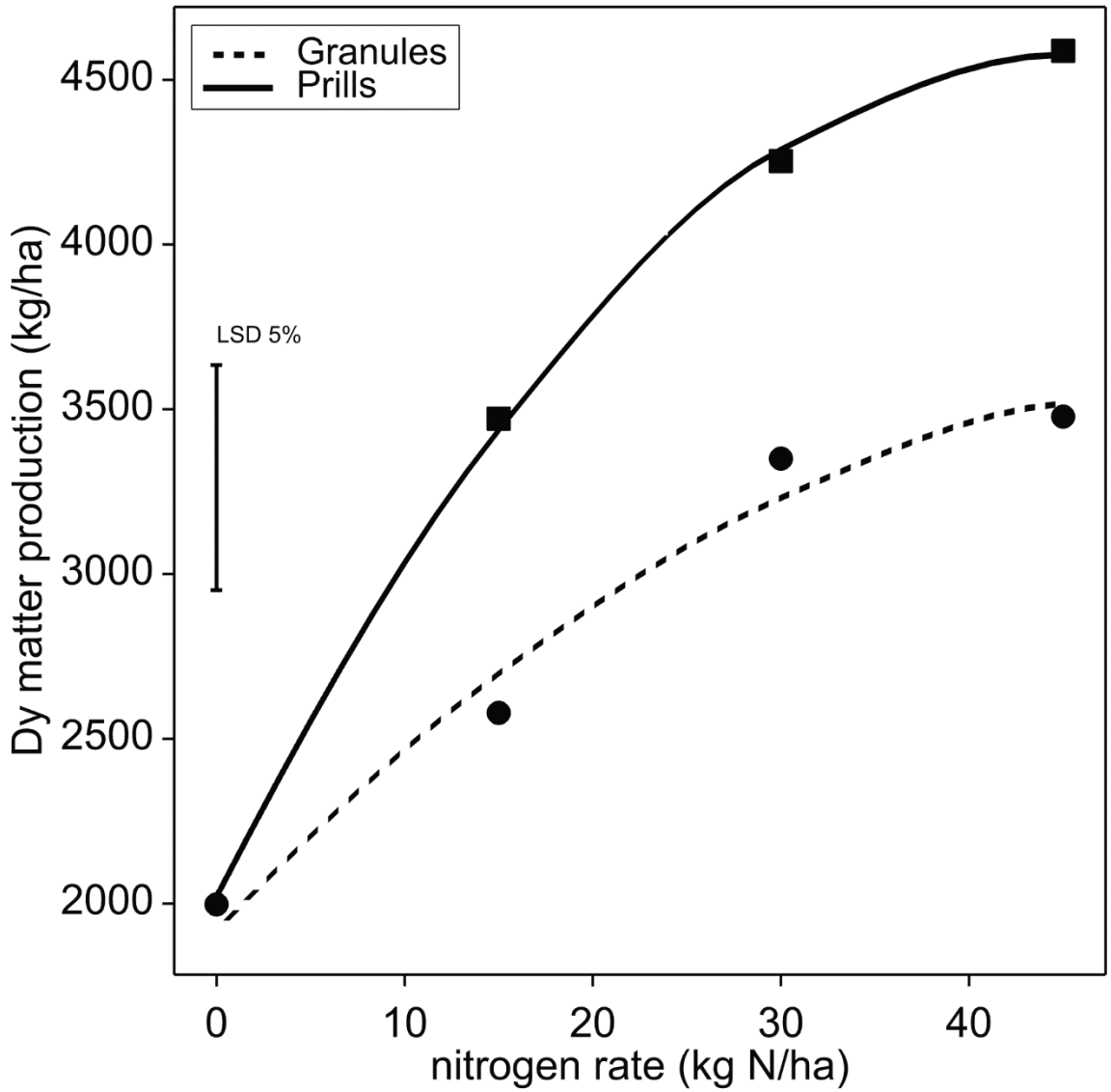
- The efficiency of granular urea was extremely poor under the trial conditions, which were typical of irrigated Centerbury dairy farms
- This efficiency is dramatically improved - by a factor of 2.5 in extra dry matter (EDM) per kg N applied terms, or 3-fold on an N uptake basis - by using ONEsystem®
- As an example, a total DM of 3230 kg DM/ha grown during spring/early summer required 4 applications of 30kgN/ha as granular urea (120 kgN/ha total), versus 4 applications of 12.5kgN/ha (50 kgN/ha total) as ONEsystem®
- This has enormous implications, both for farmers' input costs, and for Overseer outputs, for farmers using ONEsystem®
- Overall, it is estimated that ONEsystem® achieved 90% plant N recovery, compared to 30% for granular urea.

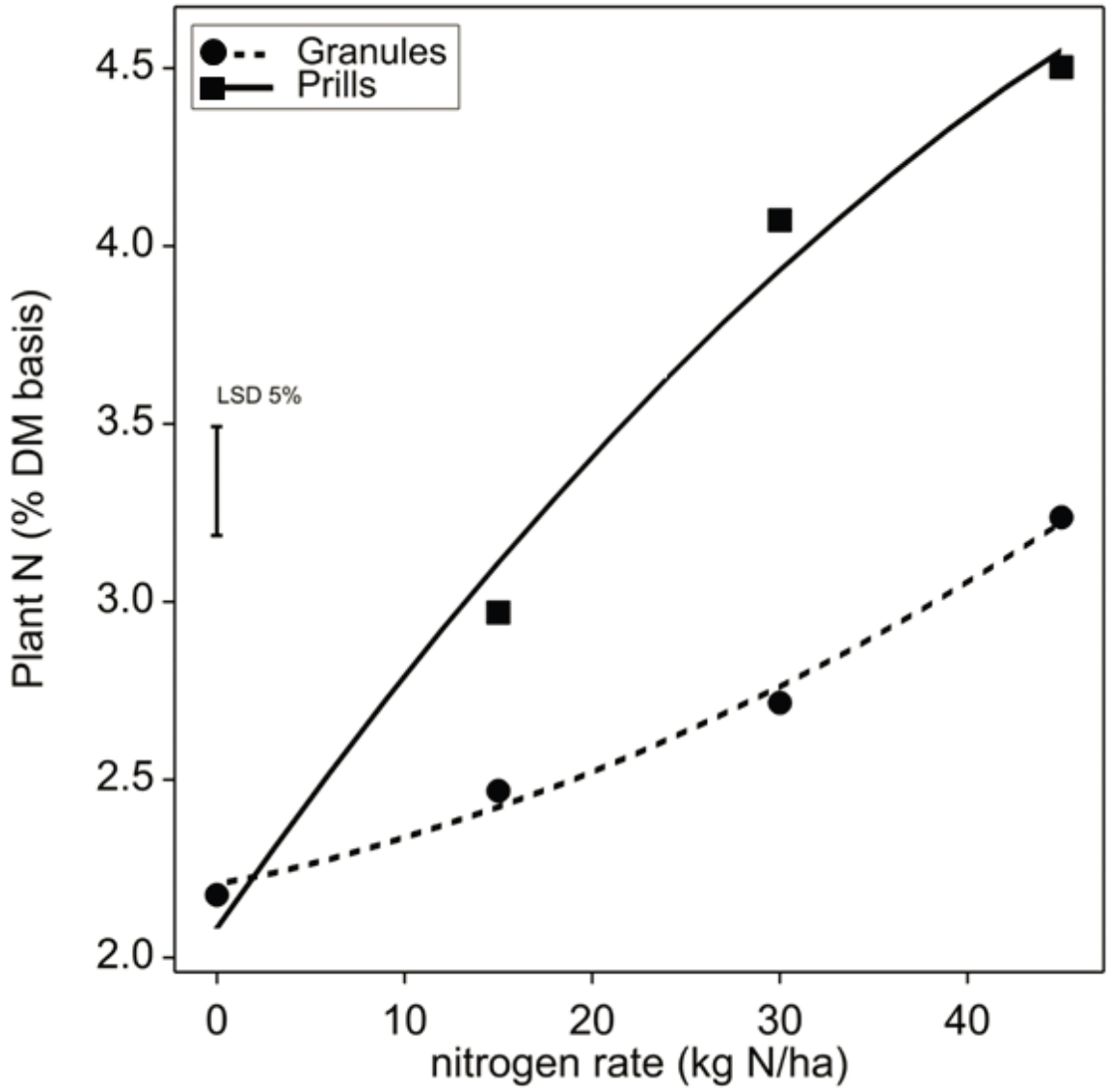
"Somewhere, something incredible is waiting to be known" *Carl Sagan*

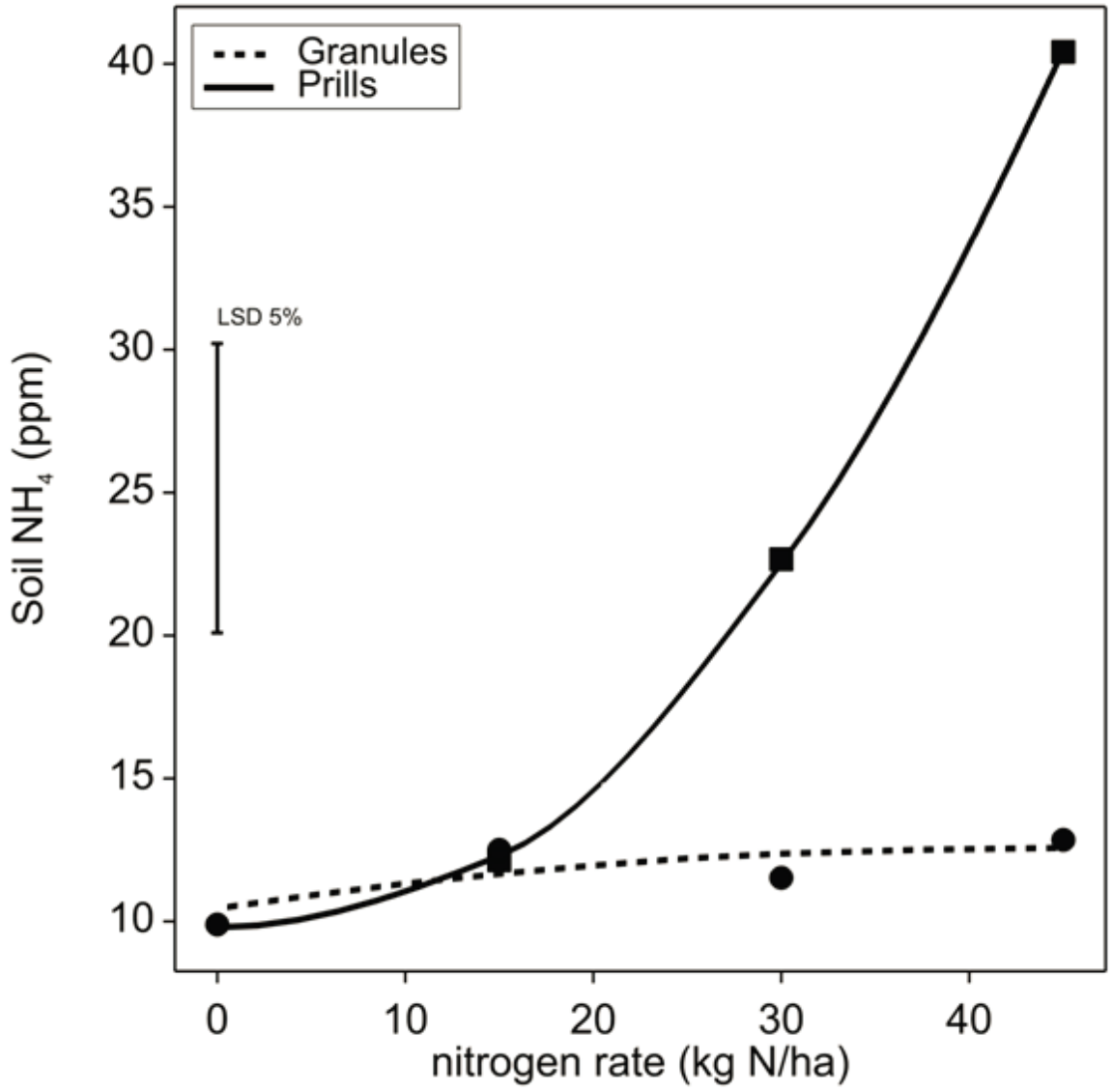
QUIN ENVIRONMENTALS

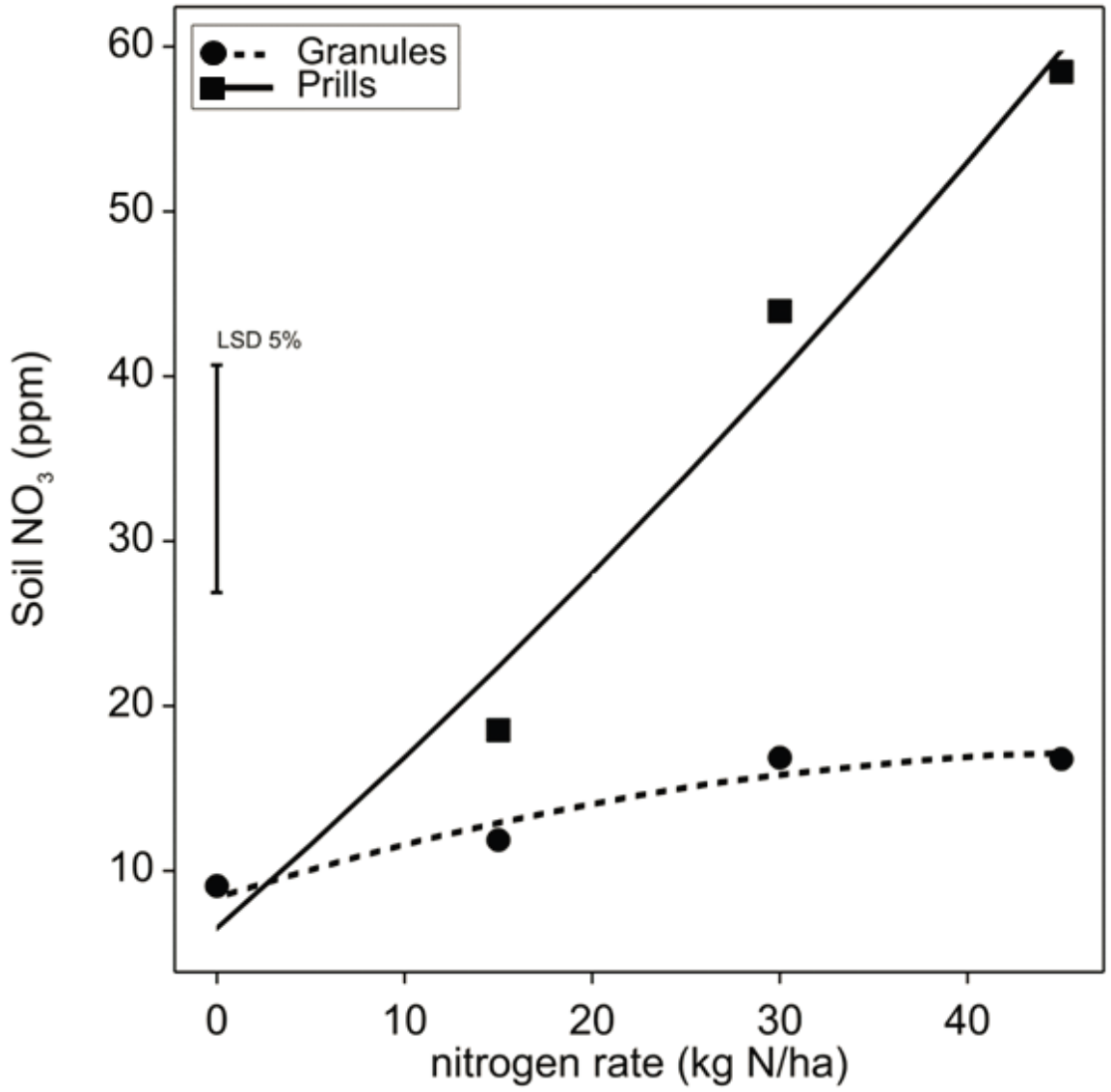
Optimising Farm Production, Protecting Water Quality

ONE System Trial Data from poster paper in larger font




Granules
Prills
LSD 5%
Plant N (% DM basis)
4.5
4.0
3.5
3.0
2.5
2.0
0
10
20
30
40
nitrogen rate (kg N/ha)


Granules
Prills
LSD 5%
Soil NH4 (ppm)
40
35
30
25
20
15
10
0
10
20
30
40
nitrogen rate (kg N/ha)


Granules
Prills
LSD 5%
Soil NO3 (ppm)
60
50
40
30
20
10
0
10
20
30
40
nitrogen rate (kg N/ha)