MODIFYING FERTILISER APPLICATION RATES
When Low Rainfall and Tough Economic Conditions Prevail

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What's in this Insight

This **IN** explores the position often faced by farmers and growers when they manage difficult periods of productivity because of adverse climatic and economic conditions. There are always difficult years imposed by low rainfall and other seasonal conditions that place stress on farm budgets. Can input costs such as expenditure on fertiliser be reduced by modifying application rates to help out at these times ?

This IN seeks to answer this question.

Preface

Following a run of abnormally dry seasons and/or economic downturns, many dry-land broadacre farmers find it increasingly difficult to grow an economically viable crop.

The vagaries of climate have always been an integral part of broadacre cropping – but with rising costs, accompanied by little (if any) rise in commodity prices – the margin for growing a successful crop shrinks, and new methods of farming and fertilising need to be considered in order that financial viability is maintained.

In response to this dilemma, farmers and growers often ask if it is possible to reduce fertiliser rates, (or even do without fertiliser altogether in some situations), and still be able to grow a successful crop ? The answer to this is not a simple yes or no, however what may be called for, and can prove useful, is a different approach to traditional methods. Most farmers, with a lifetime of growing experience of always planting with phosphorus, react cautiously to fertiliser routine modification, and continue to apply phosphorus with the seed.

However in tough economic times, or with below average seasonal conditions, there may be a case for fertiliser reduction – and in some cases even exclusion of applied phosphorus (P) from cropping systems.

By providing both scientific and anecdotal evidence from practical broadacre situations, this IN seeks to promote the discussion for modifying P application, to varying degrees, in cases of financial and climatic deficiencies.

Generally, Australian soil in its native state is low in P. But with the advent of super-phosphate, and today's compound fertilisers such as MAP and DAP (and the relative ease of their application), in many case P levels have risen – and especially so following a run of low yielding years caused by below average rainfall with its consequence of less loss, or leaching of the fertiliser.

Stored P in the soil is good news for farmers providing it can be extracted from the soil and utilised by the plant.

It should be remembered however, that there is always a range of individual factors involved in planting a crop, so considered review of all evidence, questioning and perhaps even trialling, is encouraged before embarking upon wholesale changes.

The follow discussion promotes the proposition of modifying the application of P.

Case histories and demonstration trials from the Nyngan District of New South Wales, Australia are referenced throughout this publication.

Questions to Ask before Modifying Phosphorus Application

In appraising individual circumstances, it would be beneficial to know the answer to the following questions :

1. What is the level of P in my soil ?
2. What is the availability of P in my soil (PBI) ?
3. What physical restraints are there to P uptake in my soil ?
4. What chemical restrictions are there to P uptake in my soil ?
5. How much fertiliser can I afford ?
6. What is my target yield, in relation to the financial return I require in order for the bills to be paid ?

All are very sensible, basic and common-sense questions, and together they are the important building blocks to embracing the changes needed to bring about potentially better financial outcomes.

Individually, the questions are expanded upon as follows :

- **What is the level of Phosphorus in my Soil ?**

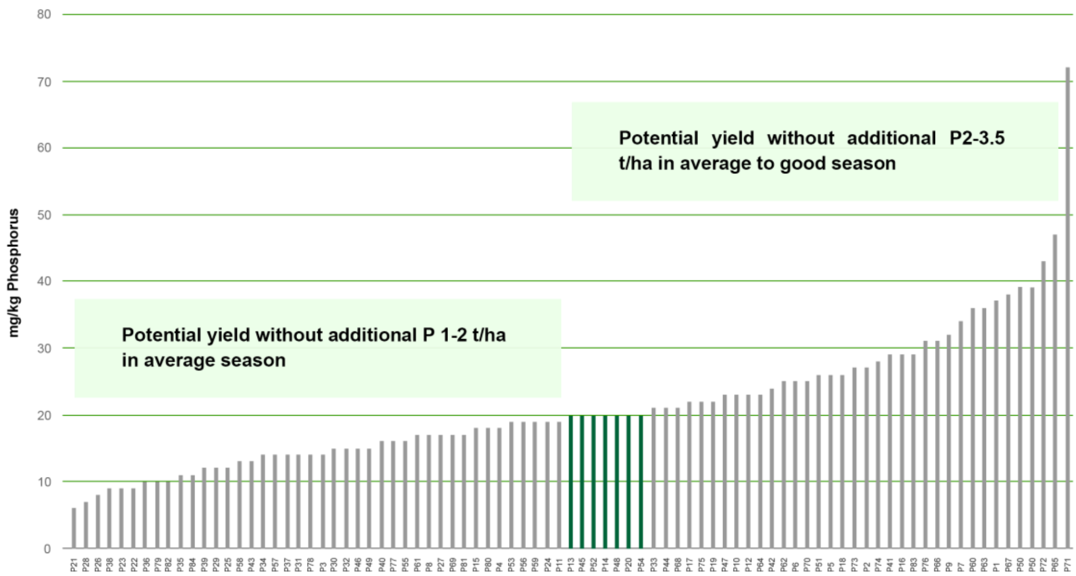
Phosphorus levels vary with different soil types, farming practices and varying P application rates.

The soils around Nyngan for instance, (in mid NSW) are in the most part red clay loams, that are quite stable in physical character and suited to large-scale broadacre farming. We know that the limiting factors for growing high yielding crops are moisture and temperature, and with this in mind some caution has to be exercised when spending funds on fertiliser.

Generally the red soils are low in nitrogen, high in potassium and low in trace elements, so there is a case for restricting soil testing to simply undertaking an audit of P, and looking after the trace minerals with seed priming and foliar applications which include nitrogen as well.

In 2008, eighty-five (85) soil test sites were mapped and the results reviewed from the Nyngan District. The graph that follows gives insight to the levels and potential yields at that time.

Phosphorus levels at 85 soil test sites in Nyngan district taken in 2008



As can be seen from the graph, there is ample opportunity to modify P strategies when P levels are above the median 20mg/kg.

Values below 20 mg/kg do not have the same potential for yield, but in times of soil moisture deficit and financial pressure, are capable of producing a target yield for the moisture and funds available without additional P.

Fertiliser management is rather like the share market, it is a risky business but becomes less risky the more information than can be brought to bear before a decision is made.

Soil sampling and analysis of results is generally undertaken by accredited soil testing laboratories. Soil samples are taken from each paddock and mixed together to form one sample, which is then sent to the laboratory. Samples are best taken after harvest, so that results can be analysed and decisions made on how much fertiliser needs to be applied to the soil in readiness for the next crop. However, soil tests don't have to be done every year, as an allowance for nutrient removal of the crop can serve just as well to establish phosphorus and nitrogen amounts taken from the harvested crop, (i.e. 1-tonne of wheat removes 3kg of P and 20kg of N per tonne of grain).

- **What is the availability of P in my Soil (PBI) ?**

The availability of phosphorus is a complex issue.

Most soils have reserves of P, but vary in their ability to supply P to the plant for some of the following reasons :

- lack of root growth restricting interception of P
- compaction of soils restricting root growth
- climatic soil conditions, either too wet or too dry
- chemical in balances in the soil (e.g. high iron, high calcium, high sulphur, high aluminium)
- low pH acid soils

"It is not so much about how much P is in the soil, it is more about how much of it is available to the plant."

A complete soil test in the hands of a trained experienced soil consultant will greatly assist in understanding how much P is available to the growing plant. This quotation sums up the essence of this question : “It is not so much about how much P is in the soil, it is more about how much of it is available to the plant.”

- **What physical restraints are there to P uptake in my Soil ?**

Compaction of the soil caused by machinery, water-logging and livestock are some of the major physical restraints to the uptake of phosphorus.

- **What chemical restrictions are there to P uptake in my Soil ?**

Chemical restrictions are very much tied to the question of the soil availability of P, but excesses of iron, aluminium and calcium are indicative, along with low pH acid soils.

- **How much can I afford to spend on Fertiliser ?**

Data gathered from many sources including the NSW Department of Agriculture suggests that on average Australian Broadacre Farmers are spending between 12 -15% of their gross revenue from crop proceeds on Fertiliser.

(A generalised explanation of this averaged fertiliser spend would be : fertiliser cost of $75 per hectare, gross return of $500 per hectare, representative application rate of 50kg MAP and 30kg Urea = $75 per hectare, and target yield 2 tonne wheat per hectare at $250 per tonne = $500 per hectare x 15% = $75 per hectare spent on fertiliser).

Simple calculation :

Area Sown		Seed	Yield		Gross Income	
Hectare	Seed kg/ha	Seed per tonne	t/ha	Total tonnes	$/t	$ Total
2,000	35	**70**	1.5	**3,000**	220	**660,000**

Using **15%** of this example equates to a total fertiliser spend of **$99,000**.

By using gross income from crop as a yardstick to establish your fertiliser spend, the variance in seasons is automatically catered for as the funds for fertiliser spend are regulated by available income. In addition to this, when yield/gross income is down, the need for as much fertiliser is less, as nutrient removal is less.

- **What is my target yield in relation to the financial return I require in order to pay the bills ?**

Realistically, each farming enterprise will need to use their own figures and pricing structures in estimating gross margins. There are many considerations in determining the projected financial return on crops. Some of these factors – with most of them involving actual costs – are the sowing time, weed control, fertiliser choices, machinery used, labour incurred and other farm overheads. In terms of crops benefiting from the availability of P and other nutrients from past cropping activity, where it sits within the crop rotation cycle is a significant factor. Obviously, rotation following pulses will attract higher target yield and financial returns over a rotation following a cereal crop.

(Reference : The NSW Department of Primary Industries keeps statistical data on dryland wheat growing outcomes that can give more insight and analysis of the costs and returns of wheat grown in the districts similar to the ones discussed in this Insight).

What Scientific Trials and Research Projects Show

Excerpts from three different studies and trial data outcomes – all relating to the question of phosphorus and the potential for modifying its application – are given in support of the proposition.

1. The Mixotrophic Nature of Photosynthetic Plants

From CSIRO Publishing, Functional Plant Biology, 2013, **40**, 425-438

Findings

Length and surface area of root hairs were significantly correlated with the depletion of P-compounds in the rhizosphere in low P growth condition.

(Bates and Lynch 1996; Gahoonia and Nielsen 1996; Gahoonia et al. 1997; Ma et al. 2001).

Long root hairs are considered a beneficial trait for sustaining crop yields in low P soil. *(Gahoonia and Nielsen 2004)*.

RLF Comment

Increasing root growth and root hair development dramatically increases P uptake and is a direct result of sowing good quality seed with high P reserve. **BSN Superstrike (BSNSS)** enhances nutrient reserves within the seed.

"Bigger root growth and more fine root hair development dramatically increases P uptake."

2. The Increase in Nutrient Levels generated through Seed Priming

From Adelaide University, Y-G. Zhu and S.E. Smith, *Plant and Soil* 231 : 105-112

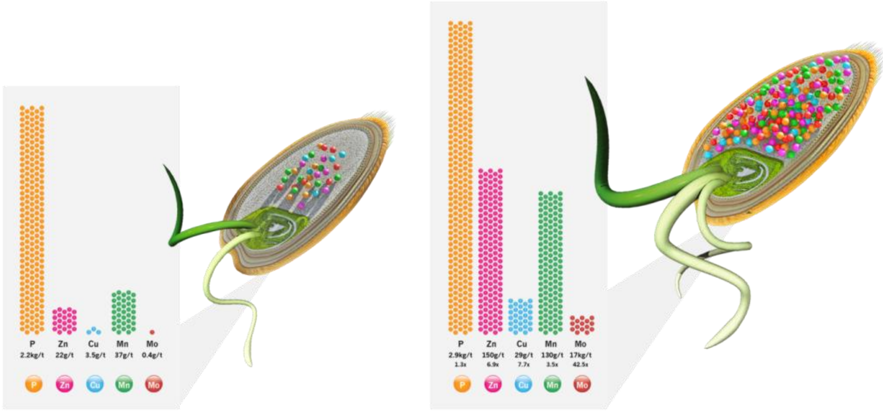
Findings

Increased seed P serves improved plant growth at rates of P supply up to and over 100mg/kg in the soil. Plants grown from seeds with high P serves tended to accumulate more P from the soil which was mainly attributable to better root system development.

From Waite Analytical Services Adelaide University 2010, Coordinator Michael Taylor Vanguard AG, Griffith NSW

Findings

Actual nutrient level increases from applying BSN Superstrike at 5-litres per tonne of seed prior to sowing.



Untreated | BSN Superstrike 5lts/tonne of seed

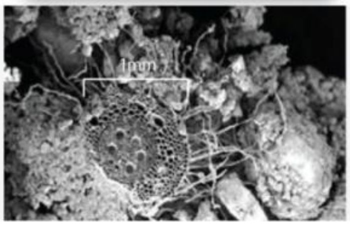
3. The Nyngan Fertiliser Trial (2008)

In 2008 a group of Nyngan farmers requested a trial to look at varying fertiliser rates to establish whether rates of P could be cut back, or omitted entirely. **BSN Superstrike** was applied at 5-litres per tonne to three plots. The other plot received just DAP. As can be seen from the images that follow, root growth and microbial activity was improved dramatically when Seed Priming **(BSNSS)** was applied.

Rhizosphere Modification

Rhizosphere of wheat root (centre ~1mm wide) with root hairs extending into rhizosphere soil.

Photo: CSIRO



The rhizosphere activity of roots is also improved by BSN and is unrelated to DAP supporting immobility of phosphorus in soil and its limited availability from seed.

NOTE :

The **BSN** only sample on the right of the image visually shows greater activity in the rhizosphere, and increased greener top growth. Current research supports that increased sugar transport from greener, larger top growth will transport to the root, which in turn support active rhizosphere.

Recent scientific evidence (excerpt: Functional Plant Biology, 2013, 40, 425 – 438) implies that:

"Microbes occur in much higher density in the rhizosphere than bulk soil and are attracted by root – derived compounds and debris, and it is conceivable that plants acquire and digest microbes as sources of nutrients. As microbes compete with plants for soil nutrients, uptake and digestion of microbes could be an adaptation for securing nutrients".

What we know about Phosphorous

The importance of the role of phosphorus cannot be over emphasised – it's role is crucial.

Equally, the importance of the role of Seed Priming cannot be overstated – as it also brings many advantages.

All added phosphorus delivered by **BSNSS** is as inorganic (i.e. available phosphorus) and it is known that the seed and plant can only use and metabolise inorganic phosphorous.

Research tells us that the typical availability of phosphorus in each seed is only about 10% of the total phosphorus, which means that the phosphorus available for seed germination and early growth is often too low. But with the action of priming the seed with **BSNSS**, the seed is provided with inorganic available phosphorus that both the seed embryo and the developing plant can access immediately. The amount of available phosphorus that **BSNSS** renders can provide up to a 350% increase to the embryo.

This early development then goes on to support greater phosphorus conversion, further providing available phosphorus to the plant for its continued growth.

If phosphorus is too low then the opportunity to set high yield potential is lost. Seed Priming with **BSNSS** overrides these uncertainties, and gives certainty to the level of phosphorous required to set the maximum yield potential for the plant.

Utilising the locked phosphorus in soil through Seed Priming has a much more practical implication than for other trace elements.

Whilst the element deficiencies such as those often seen with zinc and manganese, can be simply and effectively overcome with foliar spraying, the same is not true for phosphorous deficiency. If phosphate availability is not good, the crop yield potential would not be recovered by an in-season application of phosphorus. Again, research tells us that future agricultural practice should be structured along the lines of unlocking soil phosphorus and bringing about changes to the root structure and other physiological functions that unlock more of the soil nutrients.

This is the important role that phosphorous plays.

Phosphorus is however a finite resource, and it is estimated that current levels are expected to be halved within the next 20 to 40 years. Clearly, clever use and new technology options in support of phosphorus need serious consideration.

Seed Priming with **BSNSS** not only provides the seed with all the inorganic phosphorus it needs to establish strong plant development and growth, it also gives back to the soil through enhanced microbial activity and greater organic mass created by this same strong growth.

How RLF Products help

BSN Superstrike

Providing optimum levels of seed nutrient in a single application.

It is fast becoming the new world standard in modern farming practice where fertilising the seed is becoming as important as fertilising the plant.

By priming the seed, the level of essential elements are elevated to above optimum level. This ensures the maintenance of nutrient adequacy in the seed, because all nutrients are safely transported inside the seed to be within close proximity to the embryo. The broad spectrum nature of **BSNSS** means maximum yield potential is set, and that it does not miss out on establishing this response due to suboptimal grain nutrient levels.

Seed Priming has a direct effect on yield, since 100% of the nutrients contained within it are absorbed by the seed. It is very common in untreated seeds for nutrient levels to be at suboptimal levels, and **BSNSS** has been scientifically tested and demonstrated to improve the seed's internal nutrient concentrations. In part, this is because **BSNSS** ensures 'plant-available' phosphorus which directly influences yield potential – regardless of fertiliser rates applied to the soil – hence a direct effect on yield achieved through seed priming.

Conclusion

Growing crops can be a risky business when taking into account variable rainfall, high temperatures, rising input costs and fluctuating commodity prices. Some of these variables are well outside of the control of the farmer, but in this Insight we seek to focus on fertiliser inputs and practices, and whether or not they can be modified to suit climatic and individual economic situations – just one of the variables that can be managed to a certain extent.

The short answer, based on research and anecdotal evidence, is yes.

However, much needs to be known and understood about each individual situation, and answers and adherence to the following 'quick tips' need first to be established and then implemented :

- an estimate of the moisture available to establish the required target yield
- a soil test to establish P levels and any physical and/or chemical restrictions in the soil
- attention paid to the quality of the seed, as bigger seed has more reserves of nutrients
- undertake seed priming with BSN Superstrike to increase nutrient reserves within the seed to ensure early supply of P and zinc, essential for increased root growth and P uptake

In western NSW, where many of the trials have taken place, the major limiting factors to successful crop growing are moisture and heat.

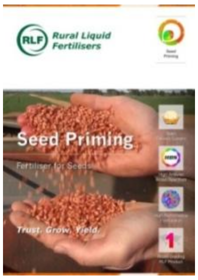
Generally there is a history of applying granular phosphorus fertilisers around 40–50kg/ha MAP or DAP, (8–10kg P/ha). Taking into account the conditions and low crop yields over the past decade, in most cases there is enough P in the soil to grow 1.5 – 2.0 tonnes of wheat per hectare, and possibly more if the season is above average. With this in mind there is an option to reduce – or even exclude – granular fertilisers in adverse seasons, or when funds are low. However it must always be remembered that crops take nutrients out of the soil, and that they need replacing to sustain production.

As an economic option to soil applied granular fertiliser in tough times, it has been proven that Seed Priming with BSNSS enhances seed nutrient reserves and will create root hair development, and greater root system exploration to extract more nutrients from the soil. The result of this enhanced ability is healthier, greener seedlings, with more vigorous root systems that photosynthesise more efficiently and have the potential to yield more grain.

RLF acknowledges that crop nutrition and protection is a dynamic business and that new ideas are often met with scepticism, however sufficient scientific and anecdotal evidence now exists to provide real insight into modifying fertiliser strategies with some confidence that in turn may deliver even better returns.

Further Useful Links

The following publications all progress the knowledge and understanding of how RLF products, technologies and concepts positively impact and play their part in achieving the outcomes discussed in this IN.



SP2015

The current Corporate Brochure explaining the full story of SEED PRIMING, together with results, images and full product details.

[Click here to view Seed Priming brochure](#)

SR3

A SR bringing together many published articles, video presentations and bulletins highlighting trial data and research results involving IFM.

[Click here to view this Special Report](#)

IFM VIDEO

RLF's Corporate presentation about Integrated Fertiliser Management.

[Click here to watch IFM video](#)

IN78

Discusses the coating of seeds with trace elements such as zinc and manganese and how it is commonly used in Australian agriculture, however RLF's advanced practice of priming the seed delivers a fully balanced broad-spectrum liquid solution of all essential elements directly to the seed.

[Click here to view this RLF Insight](#)

http://seedprimer.com/ http://www.bsnseed.com/