

# KIT 2.3

Improve wheat grain protein through increased availability of nitrogen and better nitrogen use efficiency.



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| <b>Impact</b>  | Growers achieve improved profitability by targeting the most appropriate grain protein levels coupled with improved nitrogen availability and use efficiency.   |
| <b>Summary</b> | <ul style="list-style-type: none"><li>• Grower profitability is maximised through greater market opportunities enabled by targeted strategies to deliver specific protein content or greater value from protein content.</li><li>• Grower knowledge of crop responses to nitrogen availability and use efficiency is improved, so that novel management options can be developed to optimise grain yield and protein outcomes in different environments.</li><li>• Tools and technologies are developed and adapted to support strategic and tactical on-farm agronomic, post-harvest grain handling and grain marketing decisions that deliver reliable and measurable impacts on yield, protein and profit.</li></ul> |

## OVERVIEW

### Yield and quality

Balancing the need to maximize wheat yield and maintain market quality requirements to drive profitability within a season is a key management issue for growers. However, yield and quality levels are significantly influenced by how seasons transpire and the market requirement for consistent and reliable yield by grain protein stability across years remains a challenging target given seasonal variability. Consistently delivering wheat at specified protein requirements will be influenced by climate, soil N supply and plant demand. Markets ultimately pay for protein content which in turn is influenced by millers need for specific levels of gluten. There is some variability between average protein and gluten so maximizing yield can impact protein and gluten levels differentially. This poses a potential price risk for growers depending on market requirements. Growers will need to consider the risk of trade-off in quality when maximising yields.

The goal is to maximise profit by focusing on grain yield as delivered at market protein specifications and with high functional quality. This opportunity is framed to improve grain yields through efficient use of nitrogen but with the intention of maximising revenue and profit (i.e. how protein can be managed to improve profitability). For example, this might mean choosing wheat varieties outside of current Wheat Quality Australia's APH and AH categories to focus on optimising yield and protein based on specific market needs.

### Nitrogen use efficiency

Efficient nitrogen (N) use is a priority for grain growers to optimise yield, meet target protein specifications, and manage costs. Managing nitrogen inputs, both in-season (i.e. tactically) and across the farming system (i.e. strategically) affects profitability of grain production in Australia. Applied N is the most significant variable cost to annual crop production and for cereals this is dominated by N in the form of fertilizer, usually urea. The total cost of fertiliser nitrogen (N) to Australia's grains industry is around \$1.1 billion per year (Fertilizer Australia 2018).

Plant available N affects both yield and grain protein. It impacts crop performance through genetic by environment by management (G\*E\*M) interactions, with plant available water and crop root proliferation being major factors impacting N uptake. With increasing pressure on profit margins, the grains industry needs a greater focus on increased Nitrogen Use Efficiency (NUE) in meeting yield potential. Opportunities are expected to come from improving our understanding of interactions between soil water and N supply for different wheat genetics by environmental conditions and management practices (including paddock history). This includes the need for growers to understand optimal protein targets for different varieties (protein targets where profit is maximized), and to apply N to meet plant demand not otherwise met by soil N supply.



### FUTURE RD&E FOCUS

Key Investment Target 2.3 seeks to improve Nitrogen Use Efficiency (NUE) to realise targeted grain protein markets across the Australian grains industry. For the purpose of this KIT, NUE is defined by protein yield per unit available N (or the Agronomic NUE noting that some agronomic practices can impact on both the efficiency of uptake and the plant's ability to efficiently utilize the N without changing the applied rate). The KIT closely links with KIT 3.5 and KIT 3.6 but delivers through three scope areas that are specifically focused on NUE and grain protein in wheat.

GRDC will not invest via KIT 2.3 in weather prediction (see KIT 5.1), grain functionality (KIT 2.5) or methods to gain specific market information or linkages. This KIT scope does not include social license opportunities such as nitrous oxide emission reduction, nor does it include other cereal crops other than wheat.

### SCOPE – Realisation of supply chains

Understanding of existing and new market and supply chain opportunities is improved to inform on-farm system decisions and seasonal production tactics.

Australian wheat is bought based on grain quality grades (i.e. APH, AH, APW, ASW, ADR, ASFT ANW and FEED). Some marginal benefit is obtained within these grades based on functional protein quality, but for many growers this additional margin is an opportunistic rather than an actively managed and sought benefit.

Price opportunity is complicated by market volatility. Growers are selling their grain to customers who are educated in Australia's production and supply chain nuances. For growers to make sound decisions that optimise their profitability they require transparent engagement across the supply chain. Given that Australian grain production is volatile, growers require knowledge that informs crop production and nitrogen management decisions aligned to market options and, customers require Australian supply insights and transparent traceability from sowing to point of sale.

GRDC will invest in mechanisms to better understand supply chain requirements in order to inform on-farm system decisions and seasonal production tactics and will also work with customers (grain millers) to share Australian production information.

#### **Investment Outcome 2.3.1 – Growers have knowledge of broader market opportunities that consider differences in price related to protein, to better inform crop production and nitrogen management decisions incorporating seasonal risk.**

Growers need to be able to quantify potential gains in profitability when target proteins are achieved and the trade-offs and relative risks by not achieving the target protein, including return on nitrogen investment. They also need information of market opportunities, access and trends which are relevant to their circumstances (including regional and environmental variability in market access and logistical segregations) to facilitate on-farm production decisions aimed at maximising yield at optimum quality for a specific market. There is a need to understand protein premiums, and the trade off to achieve the target protein. There is scope to evaluate and identify long-term trends in protein payment and prospects for protein premiums. Where quality targets cannot be met, premium products or alternative markets should be identified at different protein levels through innovation in functionality and/or processing efficiency (KIT 2.4 and KIT 2.5).

GRDC will invest in mechanisms to provide growers with general knowledge that aligns production decisions (including variety choices) and N management with market requirements. GRDC will also invest to assist two-way engagement between customers and Australian grain growers, and to inform other RD&E investments. This reflects the expectation that growers have the knowledge to maximise yield and deliver grain to target quality (protein) requirements, despite seasonal and market volatility. It also reflects GRDC's belief that growers need methods to attain clear information about market opportunities and expectations while customers need information that de-risks their position. GRDC will NOT provide specific market information or guidance. This means GRDC will not facilitate price or market comparisons.



### SCOPE – Improved knowledge, tools and technologies

Crop nitrogen demand and supply dynamics are determined and improved tools and technologies to utilise that knowledge are delivered.

For Australian grain growers to realise target wheat grain protein, knowledge is required to understand and quantify the dynamics of soil N supply (acknowledging that this highly linked to crop water supply) and crop N demand as driven by temporal and spatial variability. Having this knowledge based on different wheat genetics, in different environments and under alternative management approaches is foundational to the development of a broader knowledge of NUE, and the associated tools and technologies accessible to growers.

Key R&D knowledge gaps focus around the need to understand crop N demand and soil N supply dynamics and their interaction with management decisions hampered by the inherent uncertainty of seasonal outcomes. G\*E\*M interactions will impact a grower's ability to meet target market specifications for wheat protein. Across all cropping systems, growers seek the ability to make better decisions on pre-crop N placement and in-crop N application to target yield and protein outcomes.

GRDC will invest to improve knowledge, approaches, tools and technologies available to growers to assist in matching N supply to demand. This will include fundamental research on soil N supply, crop N demand, N remobilisation and N losses and as related to different genetics, environmental and management criteria.

As part of KIT 2.3, GRDC will not invest to understand N transformations and cycling, emission or loss pathways. This area of investment relates to KIT 3.6.

#### **Investment Outcome 2.3.2 – The industry has an improved understanding of the influences of crop nitrogen supply, demand and remobilisation on grain yield and protein, to inform new strategies to optimise grower profitability.**

The combination of climate risks by complex farming systems means that growers need a practical field understanding of soil N supply and crop N demand to guide nutrient management decisions. This includes improving understanding of soil types and seasonal variability on the yield-protein trade-offs that occurs.

The role current genetic attributes may have in utilising and exploiting available N requires examination. The observed increasing atmospheric CO<sub>2</sub> and higher temperatures can result in protein decline yet increasing N supply may not reverse this decline. Protein content can be increased under a warming trend, but the functional value of grain protein is lowered when produced under these higher temperatures (making it less desirable within milling markets).

GRDC will invest to provide a more detailed on-farm understanding of wheat yields by protein content for different genetics across Australian cropping environments by management practices. This is expected to include a review of knowledge plus new investments in plant N supply, demand and remobilisation in different environments (genetics and physiology by water and heat) and under alternative management practices. It is likely to include specific investment to understand the plasticity of genetics, mechanisms for protein accumulation and approaches to manipulation.

### SCOPE – Profitable cropping decisions.

Growers have access to knowledge and tools to inform whole-of-system decisions impacting wheat yield and protein targets.

Grain growers need to maximise the profitability of their farms with strategic investment decisions across all enterprises. For wheat crops, this often means prioritising yield while optimising grain protein based on probable market options (see Investment Outcome 2.3.1). This is a complex balance of needs; therefore, growers need innovative options to manage the information around yield by protein throughout the season as conditions evolve (including rainfall and temperature scenarios, and market changes). Particularly what management options they can exercise to manage in-season risk.



GRDC will invest in R&D to facilitate the development of innovative approaches, tools and technologies to increase the efficiency of N supply and to support growers maximising yield within target market specifications. Novel genetic solutions that enhance N uptake and/or N conversion to protein whilst not sacrificing yield in target environments may offer longer term efficiencies. Whilst agronomic management to improve alignment between soil and applied N supply by matching the right source of applied N (at the right rate, timing and place) to facilitate soil supply offer more immediate solutions to meet yield and target protein requirements. More efficient nitrogen fertiliser formulations (overlap with other KITS) or the conversion of soil N (including legume N) to deliver N at most appropriate times for conversion to grain protein may also provide gains in NUE. In line with matching soil N supply to plant demand, efficiencies through plant stand and harvest index manipulation may offer tactical options in crop to meet market specifications.

In all cases, investments designed to achieve higher yields and deliver grain at target protein specifications in a given season. All strategies must have a clear path to market.

Protein targets for a wheat crop is only one component of a whole of farm decision that involves the legacy of previous farming systems and the need to manage future risks of diseases and weeds within cereal crops. Whole of farm systems also include the farm's business strategy around finance, risk management, available resources and labour. Growers do not make cropping decisions in isolation to other farm factors. Investments should consider impact across the whole-of-farm system.

### **Investment Outcome 2.3.3 – Growers have access to new, innovative tools and technologies to achieve higher profit from different combinations of yield and protein targets.**

Grain growers need to maximise the profitability of their farms with strategic investment decisions across all enterprises. For wheat crops, this often means prioritising yield while optimising grain protein based on probable market options (see Investment Outcome 2.3.1). This is a complex balance of needs; therefore, growers need innovative options to manage the information around choice of varieties to optimise yield by protein throughout the season as conditions evolve (including rainfall and temperature scenarios, and market changes).

GRDC will invest in R&D to facilitate the development of innovative approaches, tools and genetic technologies to increase the efficiency of N supply and to support growers maximising yield within target market specifications. Novel genetic solutions that enhance N uptake and/or N conversion to protein whilst not sacrificing yield in target environments may offer longer term efficiencies. Whilst agronomic management to improve alignment between soil and applied N supply by matching the right source of applied N (at the right rate, timing and place) to facilitate soil supply offer more immediate solutions to meet yield and target protein requirements. More efficient nitrogen fertiliser formulations (overlap with other KITS) or the conversion of soil N (including legume N) to deliver N at most appropriate times for conversion to grain protein may also provide gains in NUE. In line with matching soil N supply to plant demand, efficiencies through plant stand and harvest index manipulation may offer tactical options in crop to meet market specifications.

In all cases, investments designed to achieve higher yields and deliver grain at target protein specifications in a given season. All strategies must have a clear path to market.

### **Investment Outcome 2.3.4 – Growers are making strategic decisions that align their farming systems with specific market opportunities.**

Strategic decisions around products and markets requires knowledge of the supply chain (see Investment Outcome 2.3.1), resource requirements (see Investment Outcome 2.3.2) to meet the profit opportunity with any given market demand and associated risks attached to any decision. GRDC will invest in support systems on market opportunities, farm performance, yield and protein targets and long-term seasonal risk trends that support strategic decision making around the risk and opportunities of wheat markets.



**Investment Outcome 2.3.5 – Growers have access to tools and knowledge that assist them to make tactical decisions driving seasonal production outcomes that take into consideration yield and protein.**

It is accepted that strategic decisions can be impacted by seasonal changes that will impact product quality either positively or negatively. The question for growers revolves around their best tactical options where seasonal conditions changes with a risk of not being able to meet their target market. This will vary by regions and seasons but having a knowledge or decision support systems on tactical responses to make changes mid-season either agronomically or targeting other market opportunities will help growers manage risk and potentially inform them on the best cost-benefit options to capitalize on any opportunities. Particularly what management options they can exercise to manage any in-season risk.

As part of KIT 2.3, GRDC will not invest in new fertiliser products (including product development). For information in this area refer to KIT 3.5.

