

KIT 1.4

Improve the potential and actual grain yield of high-value pulses, oilseeds (other than canola) and oats in profitable farming systems



Impact	Growers in current production areas have access to more reliable, higher yielding and profitable high-value crop varieties.
Summary	<ul style="list-style-type: none">• Growers and other grains industry participants understand the market opportunities for high-value crops.• New tools and resources are developed to support the genetic improvement of high-value crops.• Growers have access to high-value crop varieties possessing higher yield potential and reliability.

OVERVIEW

High-value crops such as food pulses, oats and oilseeds other than canola (which is a major established crop rather than a developing crop), are important components of profitable Australian farming systems. These high-value crops often provide cereal/canola-dominant farming systems opportunities to manage seasonal risks, break pest and disease cycles, control different weed species and, for legume crops, add nitrogen to soils. High-value crops are becoming more important for their direct cash value as prices continue on an upward trend in comparison to other crop options. Increasing demand for pulses, particularly for chickpeas and lentils from the Indian subcontinent, appears unlikely to diminish in the near term, although short-term shocks from the application of tariffs are likely to remain a feature of this market.

Another important global trend is the increasing importance of consumers/customers using diet to prevent health issues. Pulses and various ingredients derived from pulses will become more prevalent for healthy dietary options in consumer diets. Oats, which are high in beta glucans, are already an important wholegrain ingredient in Western diets, and are increasingly being favoured in Eastern diets. There is potential for Australia to become an important supplier of premium quality processed oat and pulse ingredients in global markets.

The KIT 1.4 strategy is divided into three scope areas. The strategy starts with identifying those crop options with the greatest opportunity to add value to Australian farming systems in the medium to long term. The second phase is to identify the constraints and opportunities to improving the yield and yield stability of these high value crops in their current production areas. The third phase of the strategy is delivering solutions to the constraints and opportunities identified in the 'Constraints and opportunities for achieving yield potential' scope to increasing the yield and yield stability of the priority crop options identified in the 'Demand for high-value crops' scope.

FUTURE RD&E FOCUS

SCOPE – Demand for high-value crops

Market intelligence ensures that opportunities to drive demand for high-value crops are identified and captured.

The major objective of KIT 1.4 is to improve the potential and actual grain yield of high-value crops in their current production areas. While this may involve delivering a range of agronomic and other discipline area solutions the primary emphasis of this KIT will be on crop improvement. Given the long-term nature of investment in crop improvement it is critical we choose the right crops to focus on. Therefore, to identify the most valuable crop opportunities, it is critical to have access to strategic intelligence on medium to long term market drivers and trends. Understanding these market trends is critical to identifying and capturing high-value crop opportunities, ensuring that investment in long term crop improvement and other discipline areas is both targeted and commensurate with the specific crop opportunity. Understanding these market drivers is the first phase of this strategy.



For high-value pulses, oats and oilseeds, market information currently supports the expectation that crops such as chickpeas, lentils, faba beans and milling oats will enjoy sustained growth in demand over the coming decade. However, more information is needed to identify demand drivers for other pulse and oilseed crops including mung beans, peanuts, field peas, and soybeans. Additional economic value components, such as their contributions to farming systems, nitrogen fixation, disease break, herbicide rotation, and water use efficiency, also need to be defined for many of these crops.

Investment Outcome 1.4.1 – Opportunities to increase the yields of high-value pulse, oat and oilseed crops that enhance grower profit are underpinned by sound market analysis.

Market intelligence ensures that opportunities to drive demand for high-value crops are identified and captured. While the major crops enjoy robust levels of publicly available information, reliable information on market uses and trends is more difficult to obtain for smaller crops, and often needs to be collected from primary sources rather than published information. Quantifying the value of high value pulse, oat and oilseed crop varieties to the farming system is also required to fully assess the potential contribution of these crops to farming system profitability.

GRDC will invest in the identification and capture of market information that ensures that high-value crop improvement and production is aligned to demand drivers in new and existing markets, and that the agronomic contributions of these crops to farming systems profit are quantified and understood. This information will be used to prioritise the allocation of resources towards the crops with the greatest potential to impact positively on the profitability of Australian grain growers, and to ensure that breeding targets are aligned to market needs.

SCOPE – Constraints and opportunities for achieving yield potential

Key constraints and opportunities for improving the yield potential and reliability of high-value crops in current production regions are identified.

Although broadly grown in Australia, pulses are considered more difficult to manage and generally more unreliable than many other crop options particularly the major cereal crops. Generic problems with pulses include a lack of adaptation to common Australian abiotic stresses, poor weed competitiveness, limited access to effective weed control options (herbicides), and higher levels of susceptibility to yield limiting diseases and abiotic stresses. In addition, there are less tools and technologies available for breeders to improve the rate of genetic gain and for growers to manage these crops. Taken together with market risk, these factors can make these crops overall a riskier proposition for Australian grain growers.

Unlike well-established Australian grain crops such as wheat, barley and canola, pulses have been bred for Australian conditions for only a few decades and so the genetic adaptation of these crops to Australian environmental conditions is not as advanced. More work is required to identify and integrate into the breeding programs improved tolerance to important Australian abiotic stresses such as heat, cold and acid soils as well resistance and/or tolerance to major pests and diseases. Further research is required for improved disease management technology, improved crop standing ability for ease of harvesting, as well as identifying the right rhizobia and inoculation methods which in turn will deliver optimum nitrogen fixation. All these attributes will have the potential to significantly improve the yield and yield stability of pulses.

Understanding key constraints to achieving yield potential in current production areas and identifying the genetic and non-genetic resources that have the potential to address these constraints is the second phase (scope) of this strategy.

Pulse and other high-value crops such as oats in Australia have a reputation for being lower yielding or less reliable than cereals and canola when challenged with both biotic and abiotic stresses. To enable these crops to become lower risk and more financially reliable for Australian growers it is critical that we gain an improved understanding of the key productivity constraints in different production regions, and to identify the tools and genetic resources that can be used to overcome these constraints and contribute to capturing the opportunities.



Investment Outcome 1.4.2 – The key addressable constraints and opportunities for improving yield potential and reliability in current production zones are identified and prioritised.

GRDC will invest in the identification and prioritisation of constraints and opportunities to improving yield potential and reliability in current Australian production regions. These opportunities and constraints will include but not be limited to:

- Minimising the risk of yield loss due to frost, heat and drought – sustained low or high temperatures at critical growth stages, along with temperature shocks, can significantly impact the yield of these crops. The identification and characterisation of genetic diversity to limit the effect of these environmental stresses is crucial to improving yield potential in many growing regions.
- Understanding the physiological and phenological characteristics required to maximise yield – an improved knowledge of how germplasm develops in differing regions/growing environments and an understanding of the genetic and/or environmental drivers behind the phenological development of these crops is important. This will advise breeders and pre-breeders in the design of new varieties with improved yield and yield stability in different growing environments and the development of farming systems optimised to deliver maximum profitability.
- Overcoming key biotic and soil constraints such as soil acidity, boron toxicity, salinity and sodicity has been and will remain key breeding targets, however novel or improved management tools and genetic sources of tolerance to these constraints will also be required.
- Minimising pod shattering and improving harvestability – crop losses at harvest due to shattering can be substantial, genetic and/or management options to improve harvestability, and minimise shattering are required.
- Understanding the genetic and agronomic potential to improve crop establishment under different conditions including dry sowing, and improved harvest index are opportunities to be considered.
- Herbicide tolerance systems and other weed management options will be needed to provide growers additional tools to manage weeds in these crops.
- The availability of improved modelling tools (whole farm, crop and crop sequencing) to support the identification and assessment of high impact constraints and the optimisation of farming systems that incorporate high value crops.

Other crop constraints and opportunities will be continually assessed as further high value crop opportunities are identified and evaluated.

SCOPE – Improvements in yield potential and reliability

For each high-value crop, identified constraints and opportunities are addressed to accelerate the delivery of the tools and knowledge required to improve crop yield and reliability.

The major mechanism to improve yield potential and reliability is through crop genetic improvement, through activities such as pre-breeding and crop breeding. While major Australian crops such as wheat, barley, sorghum, lupins and canola are now bred by the private sector, GRDC invests in the breeding of 10 crop species, including high-value crops such as chickpeas, lentils, faba beans and oats. These breeding programs are the primary means for Australian growers to access new varieties that incorporate genetic improvement efforts from the research community. As a result, crop breeding underpinned by sound pre-breeding will remain an important focus in delivering the investment outcomes for this KIT.

While we expect crop improvement to be a major focus of this KIT strategy there are likely to be opportunities to research and extend improved crop management tools and technologies to help Australian growers plant, grow and harvest high value crops and in turn deliver enhanced profitability.

Pulse crops have a shorter history of production in Australia in comparison with crops such as wheat and barley. Most pulse crops were introduced into Australian farming systems during the 1980's and 1990's compared to wheat which was introduced in the late 19th century. Consequently, there has been less time and research effort committed to genetic improvement and adaptation to Australian conditions. There has also been a much lower level of investment in the management (agronomy, farming systems, crop protection etc) of these crops.



Investment Outcome 1.4.3 – Growers have access to tools, technologies, varieties and products that support maximising the yield and reliability of high-value crops.

GRDC will invest in innovation that addresses constraints and opportunities to improving yield potential and reliability of high value crops in current production regions. Some of these opportunities include:

- Improved Rhizobia performance and inoculant delivery systems.
- Improving management tools for tasks such as weed control and harvesting.
- Building the knowledge of growers and agronomists in management options to optimise productivity and profitability.

GRDC has invested in crop breeding and genetic improvement of many crop species since its inception over 28 years ago. While breeding of many of the major Australian crops including wheat, barley, sorghum, lupins and canola has now transitioned to the private sector GRDC has maintained investment in the breeding of 10 other crop species. For most of these crops the breeding programs have been delivered in partnership with public sector agencies.

Investment Outcome 1.4.4 – Plant breeders and researchers have the tools and knowledge to deliver high-value crop varieties with improved yield and yield stability.

GRDC will continue and accelerate investment in world leading breeding programs that have the structure, technical capacity and supporting infrastructure to release improved varieties faster, initially prioritising chickpeas, faba beans, lentils and oats. For these priority crops, GRDC will be looking to greatly improve the rates of genetic gain achieved through breeding. This may involve investment in increased scale, throughput, development of new methods to accelerate the rate of improving genetic gain, and the adoption of new breeding technologies.

With private investment in crop breeding now well established in Australia, there is the opportunity to explore new collaborative genetic improvement models involving non-traditional partners including commercial breeding companies.

Key high-level targets for breeding programs that GRDC invest in include:

- Breeding programs that meet market requirements, are grower-focussed and target improved yield and yield stability.
- Up-scaling tools, capacity and infrastructure to maximise rates of genetic gain.
- Improving genetic tools and knowledge.
- Increasing private-sector and international linkages.

Breeding programs are large, long-term investments and it can take many years to see the results. It is critical that the resources are directed at the right long-term market opportunities. Resourcing these programs will need to be prioritised, based on potential opportunities for significant improvement and benefit for Australian growers.