QUARTERLY PROGRESS SUMMARY: April – June 2019

A New Vision for Pastoral Agriculture through Seed and Nutritional Technology Development

Summary of progress during this quarter

- Two new breeders seed crops with AR501 have established well and are being monitored. Agronomic trialling of the best AR501 lines has continued across New Zealand. A full analysis of 5-years of insect testing is now complete with superior black beetle and root aphid resistance confirmed.
- We completed harvesting ryegrass tillers for P. chartarum spore counts from all trials and completed spore counting has been completed for one harvest of the Waikato trial. Tillers infected with ARY accumulated ~50% fewer spores than plants containing AR501. We also analysed the transmission of 17 new PGP strains inoculated individually into ryegrass seed. The transmission results confirm the greater compatibility between ryegrass and PGP endophytes isolated from ryegrass than those isolated from tall fescue.
- The feed conversion efficiency project continues to make excellent progress against all objectives. In the second quarter of 2019 we analysis approximately 1700 plants and have identified the best families for use in future breeding. A new field trial in the USA has been planted with selected individuals. We have confirmed the biological impact of this trait on total gas production and methane emissions in in vitro studies with rumen fluid, with methane emissions reduced by approximately 15%, which is comparable with L. corniculatus.
- Ten new Cleancrop raphanobrassica selections have been tested for herbicide tolerance and all have passed. These lines are ready for agronomic testing with the best candidates entered for seed increase. Several new interspecific hybrids have progressed into field breeding and provide potentially novel genetic variation.

Key highlights and achievements

- Our elite perennial ryegrass selections with AR501 endophyte have improved bioactivity against insect pests and excellent agronomic performance, outperforming more than 100 other entries across 8 locations in New Zealand. Our first selection has been entered in the official National Forage Variety Trials. A series of animal safety trials have shown strong animal performance results without any adverse animal health problems demonstrating the animal safety of this endophyte. We have shown that a mix of AR37 and AR501 also provides animal health and performance benefits to a greater extent than predicted from the proportions of tillers of each endophyte strain in the blend. The genetic control of our AR501 endophyte transmission has been determined and the optimal method for progressing this to a commercial product in both diploid and tetraploid perennial ryegrass is underway. Draft seed production management guidelines have been completed based on seed production trials.
- The effect of PGP-endophytes on facial eczema spore counts have been assessed under field conditions, demonstrating a reduction of up to 40% in P. chartarum spore counts over the past 2-years. Furthermore, this level provides similarly low levels of facial eczema challenge as those observed with tall fescue – the best current forage option. The histology and haematology results from our animal toxicology study have shown no adverse effects of these endophytes in small animal studies. Selection has improved transmission of ARY in perennial ryegrass but still needs further improvement to justify proceeding with an animal safety trial. Several new PGP-endophytes with bioactivity against facial eczema have been identified and are in the development pipeline. A new

assay has been developed for rapid identification and quantification of several new PGP endophyte strains.

- We have demonstrated improved water-use efficiency (+38%), aphid tolerance (+32%), clubroot resistance (100%), lower glucosinolate levels (-80%), excellent seed yield potential and improved agronomic performance (+14% DM yield) from Pallaton raphanobrassica compared to Goliath rape across a range of regional sites. Furthermore, our cattle grazing trial resulted in ~30% higher liveweight gain per hectare without any increase in brassica associated liver disease. Initial on-farm studies have also shown strong improvements in lamb finishing systems with >$2,000/ha profitability gains compared with forage rape and grass pasture.
- A nucleus crop of Pallaton raphanobrassica was produced in early 2016 with further crops harvested in Canterbury in early 2017, 2018 and 2019. The seed yields have exceeded the target by at least 30% with yields averaging >2200 kg/ha. This product is now fully commercial with approximately 6,800 ha of Pallaton sown across NZ in 2018/19. DM yield and liveweight gains to date have been very encouraging. A stand at the national field days at Mystery Creek in 2017 and 2018 highlighted the knowledge we have developed from on-farm use of this project over the past year. Pallaton has been granted Plant Variety Rights in New Zealand. Strong performance of Pallaton has been reported across regions of New Zealand that experienced severe drought stress in spring and early summer of the last two years.
- Firefly Cleancrop Kale has proven tolerant to Telar herbicide under worst case scenarios and has shown good agronomic performance at regional evaluation sites. A pre-nucleus seed increase was harvested in Canterbury in early 2017 with nucleus crops harvested in early 2018. Cleancrop Firefly kale is now fully commercial with approximately 7,200 ha sown this year across New Zealand. Reports on performance to date have been excellent. A Plant variety rights application is in its 2nd year. We also completed the cattle grazing trial of Firefly kale in winter 2018 in North Canterbury and no animal health issues were identified.
- Glucosinolates levels for both Pallaton raphnobrassica and Firefly kale have been measured at two locations. The levels of three key glucosinolates were very low compared to both Regal and Sovereign kales. This should improve animal health outcomes for New Zealand livestock systems.
- Several new interspecific brassica hybrids have been developed and are beginning evaluation and several potential new sources of clubroot tolerance have been confirmed. A road map has been developed to discover, validate and implement molecular markers to pyramid clubroot resistance loci to achieve multi-strain clubroot resistance.

Upcoming

- New tetraploid perennial ryegrass multiplications with AR501 will be monitored.
- Results from trials in the Waikato and Manawatu will be analysed to determine the impact of our PGP endophytes on facial eczema in autumn 2019.
- New seed increases of ARY have been sown at Lincoln to produce seed for animal safety trials and to determine its efficacy for commercialisation.
- Performance will be monitored in our 3rd field trial in USA. Elite selections will be progressed in the breeding programme. Methane mitigation results will be reported and discussions with the NZ Agricultural Greenhuse Gas Centre initiated.
- Cleancrop raphanobrassica regional trials will determine the effect of timing and rate of herbicide application evaluated.

Investment

Investment period	Industry contribution	MPI contribution	Total investment
During this Quarter	$276,400	$304,353	$580,753
Programme To Date	$7,647,813	$7,317,851	$14,965,664