

# FINAL REPORT

DAQ00023

## Adoption of best management practices in high input peanut production systems

### PROJECT DETAILS

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PROJECT TITLE: ADOPTION OF BEST MANAGEMENT PRACTICES IN HIGH INPUT PEANUT PRODUCTION SYSTEMS

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### Summary

High input peanut yields generally range from 30 to 50% of genetic potential. Commercial yields of two to five tonnes/hectare are common (industry average < 4t/ha) representing significant yield loss. Past work has identified barriers to change, including lack of application of improved production techniques and varying attitudes to risk management. Trial work to date indicates a number of agronomic factors are responsible for this 'yield gap' including irrigation and disease management, plant population, rotations, weed control and harvest losses. This project extends the wider application of recognised best management practices aiming to lift productivity to average 5.5t/ha on irrigated production.

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## Conclusions

Growers and agronomists are keen to partner the development of improvements to applied best practices to drive yield, quality, cost efficiency improvements and profit gains. The Peanut Company of Australia (PCA) and some individual consultants have been keen proponents of information development and have added further value to project outcomes through their own field service staff and industry meetings with growers. PCA has also co-invested and capitalised on project outputs through expansion to include new growers and production areas with a higher chance of success given the improved industry technical capacity and the implementation of decision support tools to model appropriate production strategies.

Stakeholders have not been widely aware of the key elements of Best Management Process (BMP). This includes most consultants not involved specifically in the peanut industry and therefore not necessarily able to easily develop and deliver the level of technical capacity needed for the peanut industry to operate at an optimum level.

Important findings include the realisation for processors and producers that peanut yields can move significantly upwards with useful gains in quality, processing efficiency, water use efficiency (WUE) and profit at all levels of the value chain. The industry has surprised itself in terms of the increasing incidence of very high yield reflecting 80-100% of readily expressed genetic potential and exceeding 6.0t/ha and up to 8.0t/ha pay weight.

Given the range of yields achieved by growers participating in the project, the wealth of information on BMP and the further application of decision support tools, there appears to be excellent potential to move peanut productivity considerably higher to a level similar to the cotton industry in terms of productivity, quality and risk management in a sustainable production system. Clearly the international price trend presents some difficulties for the domestic industry but there is still significant potential to overcome this through direct productivity gains and added competitiveness in the value-adding sector.

Levels of expertise in the peanut industry are rising and growers and agronomists are responsive to efforts to develop a better understanding of the science and its practical application. Consultants are those with the best vested interest and closest working relationship with producers. They can continue to increase the efficiency of information delivery, provide an improved conduit for technology access and generate a means of field testing applications as well as providing valuable industry-wide feedback.

The top 20% of high input/irrigated peanut producers are achieving yields in excess of 6.0t/ha pay weight which can provide exceptional returns and underpins a sustainable basis for industry consolidation and expansion.

## Recommendations

These recommendations form the basis of the new GRDC project proposal 'Tool kits for BMP in Peanuts - development extension for rapid adoption of decision support using commercial industry networks'. The emphasis is clearly on the success rate that regional consultants achieve in assisting growers implement best practices and drive yield, quality, profit and

industry expansion.

At the same time, the industry can only effectively move to the next level if growers understand and implement more of the tried and tested BMP approaches on a daily basis and work to make more effective economic and financial decisions about profitability, farming systems sustainability, farm resources and capital expenditure to support improved productivity.

Easy access to web-based information support systems and decision support tools including Aquaman, Smart Peanut, APSIM Peanut crop modelling outcomes and remote sensing capabilities will be important elements of this work. Further development of improved planting configurations also has proven to have significant scope for regional application to manage crop maturity, improve yield, profit and water use efficiency. Linkages between industry agronomists, researchers and extension staff will be important in driving this agenda and making sure outcomes are delivered in a practical, applied framework at a regional industry level in growers' fields.

## Outcomes

This project has helped lift high input peanut yields in Australia to 4.7t/ha average with growers reaching up to 80-100% of genetic potential according to the Peanut Company of Australia (PCA) intake figures. The improved skills base of growers and agronomists has considerably reduced risk factors associated with high input costs. Access to higher value Australian markets has been assured with higher quality nut products displacing cheap imports and improving local value adding potential. The work adds value to past research by confirming important 'yield gap' factors, especially poor irrigation, foliar and soil-borne disease management, poor rotations and harvest losses.

Expansion is driven by improved returns/returns per mL, reduced risk and cotton, grains and sugar industry diversification with special importance to cane growers seeking to boost sugar yields and generate additional cash income from cane fallows. Cane growers (Ayr/Mackay/Bundaberg) have identified the real value peanut rotations contribute to cane productivity (up to 30% yield increases).

Increased domestic demand for peanuts has been met with reduced need for imports that threaten the local industry. End users can invest in peanut product development and expansion based on high quality, locally available kernel. Local and export market requirements for specific grades of peanuts are being met under BMP with increased opportunities to supply niche high-value, export markets while competing with cheap, lower quality imports. BMP information is assisting continued expansion and entry of new growers to meet increased demand. This is also reflected in lower cost per tonne of production for some (but not all) growers and the diversified interest from the regional cotton, grains and sugar industries. Crop modelling software and remote sensing have been confirmed by stakeholders as viable decision support tools with industry-wide application.

Estimates indicate that by realising the genetic potential of existing varieties (i.e. raising pod yield from 3.5t/ha to 4.7t/ha average), the benefit to growers and the processing industry would be around \$6.5 million and approx \$13 million, respectively.

Important environmental outcomes include improved WUE, a reduction in nitrogen application and improved soil health (especially for cane growers) which reduce agricultural impacts on the Great Barrier Reef marine ecosystem. Better understanding and management of fungicides has improved efficacy and reduced overall rates of application and the chances of fungicide resistance developing. Insecticide use is minimal in response to an improved understanding of Integrated Pest Management (IPM).

From a social perspective, peanuts now have a lower risk profile in areas where they were previously relatively unknown, especially in coastal farming systems. Confidence and competence with peanut crops has grown, generating wider acceptance by growers and financiers which will assist industry consolidation and expansion.

## Achievements/Benefits

### Outputs

Thirteen 'Nuts 2 U' newsletters, three CD ROMS, Bundaberg and Atherton Update, Kingaroy Update, final CD with BMP in Peanuts manual in process.

Activities - Central and Southern Queensland only

## Irrigation

Year 1. Two farms (Bundaberg and Kingaroy) monitored with Diviner probes for irrigation management. Demonstration of irrigation calibration at field days in Bundaberg and Wooroolin. Farm outputs were also monitored in North Queensland with an emphasis on irrigation inputs.

Outcomes: Realisation that growers were not irrigating to full potential in the Southern Queensland region. In North Queensland growers who watered when necessary produced higher yields of peanuts than those who did not irrigate while waiting for predicted rain.

Year 2. Four farms (three Bundaberg and one Kingaroy) monitored with Diviner probes.

Outcomes: Better irrigation by adopting growers. Many growers still do not appreciate the need to irrigate to maximum potential especially in wetter regions when irrigators were used only three or four times. Many crops suffered between rainfall events. Need to better convey the message to growers.

Year 3. Six farms (four Bundaberg, one Chinchilla, one Texas) set up to use the Aquaman irrigation scheduler. Two of the Bundaberg farms also monitored with the Diviner probe as a check.

Outcomes: One farm did not use the system due to an extremely dry season and having to water 24/7 as he did not benefit from in-crop rain (this grower still sees value in Aquaman). Other growers used it reasonably effectively. Comments such as "I am watering 1-2 days earlier than I would have otherwise done" show the worth of the system. Aquaman contributed to high yields in a very dry year, was extremely easy to use and provided a very good guide to irrigation scheduling. Probes confirmed these farms were not drawing water below 60-70cm. It clearly assists growers in making irrigation decisions after a rainfall event. Growers and consultants have suggested changes to the system (mainly layout of the program and what data are presented). Aquaman should be a major activity in future work with irrigated growers.

## Remote sensing

Year 2. Aerial infrared images taken of some Bundaberg farms on several occasions.

Outcomes: Showed this technique can be used to monitor various stress types including picking up stress from what appeared to be peanut rust before the rust was seen at ground level. It included areas where peanuts were grown following peanuts with disease developing at a different pace to where peanuts followed fallow or cane. Ground-truthing by taking yield samples revealed dramatic differences in different areas showing the value of this technique as a monitoring tool. It also picked up different areas which could only be a result of identifying different cropping histories. In high disease areas, the usefulness in identifying disease is somewhat negated by then having to spray fungicides but it can still provide an early warning tool for potential problems. This could be a useful monitoring tool in other areas.

Year 3. Further infrared imaging carried out using satellite.

Satellite imagery was used to monitor 12 farms (26 fields) following success with this imagery in other projects. With ground-truthing, areas of poor watering (due to different soil types) and waterlogged areas (end of irrigation runs) were identified. Further efforts to monitor changes in the same area were frustrated by the inability to obtain further satellite imagery due to cloud cover. Future monitoring in coastal areas will have to involve both satellite and aerial imagery to suit the particular weather conditions.

## Disease

One of the major constraints in obtaining high yields has been the incidence of disease in peanut crops in coastal and North Queensland areas. Spray technology (see next section) has also been addressed.

Year 1. Monitoring disease incidence on farms and recommended changes where necessary. As project officers did not commence this project until the season was well underway, recommendations in this area were too late for the current crop.

Outcomes: Monitoring showed a large number of leaf diseases were responsible for limited yields in areas such as Bundaberg. This may be due largely to lack of early protectant fungicide sprays and lack of urgency in the timing of subsequent sprays. In

many cases, an extensive dry period in the early crop cycle meant growers did not apply protectant fungicides until as late as 10 weeks after emergence (they should be applied at 3-4 weeks after emergence) because the diseases at that stage had not been picked up in the field. Subsequent fungicide applications should have been applied at 10-14 day intervals. This urgency did not appear to be conveyed to growers (often growers were applying fungicides as late as 20 days after previous applications). This project demonstrated the urgency of closing up application times, however by then it was too late to successfully manage control of the disease, despite growers spending large amounts of money in an attempt to do so. (Some growers spent \$700/ha trying to control diseases).

North Queensland growers also appeared to not have diseases under control, despite this area having grown peanuts for a long period of time. This region, however, is more difficult from a climate point of view (more wet periods and therefore inability to start spraying after rainfall events,) as well as the fact that peanuts are not a major crop compared to other high value crops such as potatoes. Project officers found growers in this region more difficult to adopt change in this area due to entrenched ideas. (See spray technology section).

Year 2. Following lack of information amongst growers in the southern coastal regions the previous year, a great deal of effort was placed on achieving good disease control in the second year of the project. This was carried out through personal contact with growers providing published material, as well as information from plant pathologists and other sources.

Outcomes: Many growers improved spray inputs for fungicides to recommended intervals and the starting date for fungicide applications. Disease control was also improved for the season. Little work has been carried out in coastal areas on fungicide spray intervals so recommendations were based on suggested spray intervals by pathologists. Despite growers in many cases strictly following recommendations, some disease was still present in the crops overall.

Year 3. Information for disease control in the southern coastal regions. Due to the previous year's results, it was decided to change recommendations for the year, base them largely on chlorothalonil<sup>#</sup> (protectant), but with much reduced spray intervals (10 days instead of 14 day schedules). This would be more affordable for growers in such a high cost environment.

Outcomes: Disease control for the 2004/5 peanut crop was generally excellent, due to shortened spray application intervals and possibly due in part to the extreme dry period in the latter part of the growing season. It is also believed to be largely due to shortened spray intervals (as in irrigated crops) and despite dry weather, conditions for disease development are still good. Next season should confirm this. Yields in the southern coastal areas were exceptional in 2004/5 with better disease control believed to be the single most important contributor. Disease control in North Queensland was average. (See section on spray technology).

## **Spray Technology**

At the start of this project it was believed spray technology had a big part to play in contributing to Best Management Practice in High Input Peanuts. Irrigated peanuts present a very difficult target to aim spray droplets into the bush canopy.

Year 1. Assessments and some recommendations were made in the first year of the project.

Outcomes: While growers were using adequate equipment, following the bad disease incidence, it was decided that growers needed to be made aware of the latest technology. If disease control was to be achieved, the best possible spray equipment/configuration needed to be used.

Year 2: Two spray application field days in collaboration with Graeme Betts, Ask GB, were conducted in Bundaberg and Burnett early in Year 2. Grower attendance was partially funded by FarmBiz. These were well received with many attendees changing their nozzle configuration as a result of the workshops. Results were published in the 'Nuts 2 U' Newsletter. A third field day was conducted using Graeme Betts' recommendations at Bundaberg. This was conducted late afternoon/evening so growers could see the results with fluorescent dye and UV light. Disappointingly a suggested workshop for North Queensland was rejected by local growers. There is a need in the north to bring growers up to date in this area as future yield gains may be capped by disease control issues.

Outcomes: Graeme Betts recommended a specific nozzle configuration in some areas such as Bundaberg with a high incidence of windy days. Most growers in the southern regions adopted the suggested configurations. This is also believed to have contributed to better disease control in Years 2 and 3. The recommended configurations are quite adequate.

## **Weed Management**

Weed management is critical to high input peanut production. To promote good weed management, general extension methods were used.

Year 1: Consisted mainly of an assessment of the situation and reporting to growers and agronomists.

Outcomes: Many weed management situations over the whole state were inadequate with weed control ranging from very good to poor. Assessment of the situation suggested that growers were consistently leaving weed control too late. While there is a suite of herbicides available to control advanced weeds, many weed studies suggest allowing weeds to reach an advanced stage is not good weed management and also reduces yield. Strategies were put in place to achieve good weed management using basic extension methods.

Year 2: As for Year 1, but with strong emphasis on good early weed management. Several farm walks were conducted on weed management and information also provided in the 'Nuts 2 U' newsletter. Because of the disease incidence in southern coastal and northern regions, some emphasis was placed on controlling volunteer peanuts so that a common source for disease infection was reduced.

Outcomes: Weed management in Year 2 was better than Year 1 but many growers and consultants were still waiting too late to control weeds. Some growers planted before seed bed weeds were under control and then got caught out by wet weather. This provided a valuable lesson for those involved and to the peanut growing community overall.

Year 3: Activities were as for Years 1 and 2, with more timely intervention as necessary.

Outcomes: General weed control in Southern Queensland regions was excellent. Growers are also more aware of controlling volunteer peanuts and most are making a concerted effort to do so. QLD cane growers are applying for a permit for Express<sup>®</sup> on behalf of members who also grow peanuts to control volunteer peanuts. This permit should be available next crop cycle.

### **Farm Records - Gross Margins**

One aspect of farm management covered and promoted during the project's life is record keeping.

Year 2: A Gross Margin spreadsheet was constructed specifically for peanut growers. This not only calculated Gross Margins for growers but also acted as an electronic record keeping program for activities involving peanut farming. Links were formed with other DPI&F groups (FutureCane) that also promoted whole farm record keeping in sugarcane rotations. A workshop was held in Bundaberg to promote and encourage growers to use the Gross Margin spreadsheet.

Outcomes: Following comments from growers, the spreadsheet was revised and distributed to peanut growers statewide with favourable endorsements.

Year 3: Spreadsheet revised and redistributed to peanut growers following comments from other growers, and as growers had a chance to use it.

Outcomes: Some growers are now either using the spreadsheet or other Gross Margin calculators or using simpler versions of their own. Other growers are aware they need to work out the costs of their farming enterprises and have devised methods to calculate these costs. Some growers in the Bundaberg area have approached the FutureCane group to calculate their whole-farm gross margins. This project has increased the awareness of the necessity for this work and will also lead on to Smart Peanut, a higher level economic analysis of farming activities, which will be promoted by consultants and Queensland Department Primary Industries and Fisheries in future projects.

### **Nutrition**

Nutrition of irrigated peanuts handled in a general extension manner

The results of the nutrition sections of the Bundaberg and Atherton peanut Updates were communicated via 'Nuts 2 U' and a nutrition workshop for consultants held in Year 3. Issues of cadmium contamination were dealt with at Atherton/Mareeba and Bundaberg areas and extended in conjunction with related project field days.

### **Project field days and workshops**

Spray technology (four events), nutrition (two events), varieties (three events), diseases (four events), bio-solids use in peanuts and interactions with zinc and cadmium uptake, irrigation (four events), weeds (five events), multiple row plantings (four events).

Peanut Updates (three) - one at Kingaroy and one each at Bundaberg and Atherton, workshops (four) - GRDC Grains Update in Ayr, Mackay and Atherton, spray technology workshops for agronomists and growers (four), workshops for consultants (two) - Smart Peanut and crop nutrition.

## Other research

Row spacing, planting density and planting date interactions

The most apparent findings included the role of closer planting configurations and planting densities to affect crop maturity, yield, quality and aspects of water management and water use efficiency. Higher plant densities and closer row configurations can assist with hastening crop maturity, capturing more light with earlier development of full crop canopies and providing better weed control. A reduction in the growing period can also assist with total water use, curtail late fungicide applications and allow better management of harvesting strategies.

Higher density plantings may also allow further manipulation of the planting and harvesting window as well as impact positively on overall crop yield and production efficiency. Closer row spacings also have the potential to generate high yields from shorter duration varieties where the growing season is curtailed or available water is limited. This work has further potential for investigation in the new Peanut BMP Tools project.

Remote sensing applications

Rapid advances in peanut crop monitoring and interpretation of remotely acquired images has a great deal of potential for assisting growers and agronomists with strategic management options. This ability will be enhanced by further developments in the rapid acquisition, interpretation and distribution of information to growers using a web-based interface. Yield forecasting potential is important but the more useful applications will potentially include irrigation management, monitoring of spatial variation in field performance, diagnostics for nutrition, disease, maturity and peanut quality.

Smart Peanut

This suite of software offers growers a large range of practical applications for financial and economic management. It has application to individual and regional farming operations, is a useful discussion and learning tool, provides opportunities for consultants to help growers manage the big picture decisions in terms of investment and long-term viability, and can be used to test scenarios in various farming systems and enterprise mixes. Smart Peanut has also created considerable interest from bankers who underpin industry investment and risk management. Smart Peanut has the additional potential to be far more widely applicable across other grain commodities and farming systems aside from peanuts because of its sheer capacity and dynamics.

## Intellectual property summary

The software used to develop the decision support tools is either public domain or held under existing IP arrangements between DPI&F, GRDC and CSIRO. Potential exists to develop IP rights over the packaging, presentation, supporting documentation, web interface and decision support outputs from the modelling activities.

The actual potential for licensing IP from this work is uncertain but will depend on the project outcomes, relative value and application of the end products and the degree of eventual uptake by the peanut industry. The real IP implications may arise from the application of similar decision support approaches for the wider grains industry and will be investigated in the new Tool kits for BMP in Peanuts project.

## Additional information

Fourth International Crop Science Congress, Brisbane, October 2004 as appear below.

Best management practices - a multi-disciplinary approach to improving the yield of high input peanut production in

Australia.

Greg Mills, Jim Barnes, Graeme Wright, Nageswararao Rachaputi and Michael Hughes

Application of remote sensing technologies to improve yield and water-use efficiency in irrigated peanuts.

Graeme Wright, Andrew Robson and Greg Mills

Assessment of peanut crop maturity and yield forecasting with Quickbird multi-spectral satellite imagery

Andrew Robson, Graeme Wright and Stuart Phinn, Spatial Science, August 2004.

An extensive list of conference papers and presentations is included in the Annual Peanut Industry Updates in the past project reports and the BMP Practices in High Input Peanut Production CD-Rom.