INTERNATIONAL FARM MANAGEMENT CONGRESS 2003
FARMING AT THE EDGE

INNOVATIVE TECHNOLOGY INSPIRES EFFICIENCY GAINS IN A BROADACRE WESTERN AUSTRALIAN CROPPING SYSTEM

Mr. Glenn Fretwell

Farm Owner and Manager, 'Katandra Agribusiness'
Mount Sheridan Road, Newdegate W.A. 6355

glenn.fretwell@wn.com.au

Abstract

This farmer utilizes cutting edge technology to drive business efficiency, profitability, along with agronomic and staff managing practices. This 5,300ha continuous cropping operation at Newdegate WA relies on advanced agronomic practices to assist the sustainability of the fragile landscape. This efficient and innovative use of machinery and labour is necessary to compete as a low cost producer of purely exported grains.

Automatic steering devices, accurate within five centimeters, are fitted to all machinery for planting, fertilizing, spraying and harvesting operations. Machines are 9, 18 or 36m wide and their wheel position is standardized. This system allows for the controlling of soil compaction into precise pathways; the elimination of over and under lapping of machinery passes; accurate placement of seed and fertiliser adjacent to previous furrows; greater control over residue management; and the innovative use of knockdown herbicides applied within crop using a between row application. Variations in operator skill level are eliminated whilst reducing operator fatigue.

A combination of eight years of satellite derived crop biomass imagery, three years of harvest grain yield data, a digital elevation map as well as comprehensive soil analysis, are overlaid into one data set to accurately define productivity zones across the farm. Nutrient inputs are varied in accordance with yield potential across the productivity zones for optimum profit management.

Farming System Overview

This farming enterprise is a continuous cropping system in remote and dry land Western Australia (W.A.). The family operation, typical of many large-scale grain farms in W.A., is situated at Newdegate 440 kilometers to the south east of

Perth. Crops include hard wheat, malt barley, canola, lupins and field peas. Each field is cropped every year in a sequence of cereal, legume and oilseed rotations. Unusual for WA, sheep have not been a part of this farm for twenty years. 3,600ha is cropped on the home farm and a further 1,700ha on sharefarm. The fragile sandy gravel through to sandy loam soils receive on average 350mm of annual rainfall and 250mm in the growing season April to October. All grain is sold to through statutory monopolies to export markets. The ten-year average cereal crop yields are approx. two tonnes per hectare. Low inherent grain yield requires scale and efficiency to survive. The operation is managed as a father and son team with no permanent staff. We manage with the common global problems in agriculture of isolate communities suffering rural population decline and declining terms of trade. We have made full use of available innovative technology in our broad acre agriculture to help drive farm profitability and agronomic management.

Hands Free Steering

Each tractor, sprayer and harvester on our farm is fitted with an automated steering device utilizing GPS satellites with local base station and electrics over the hydraulics to guide the machine in straight lines with a high degree of accuracy for pass to pass operation. This technology, provided by Beeline® Technologies as Steering Assist™, is Australian developed and world leading in this business. This innovative technology allows advanced agronomic practices and leads to many business management profits. We would be one of very few cropping farms in the world that can lay claim to operate with this degree of automation for *all* field operations.

Controlled Traffic

We have standardized the width of each machine used for our farming operations. We harvest with 9m wide harvester platforms, plant with an 18m wide planter, and spray with a 36m boomsprayer. This simplifies in field pass guidance. The wheel equipment on each machine has also been standardized so that all tyres are three meters apart from side to side. Traffic from each operation then passes in precise pathways along each field run. This system of farming is known as Controlled Traffic or alternatively 'tramlining'. The auto-steering ensures that each machine pass repeats precisely along the same route time after time.

A change in the farming system by controlling all traffic into permanent tramlines allows for many agronomic and business management advantages.

- Reduced overlap leads to input cost savings.
- Tramlines mean simpler navigation for all workings.
- Soil compaction control allows for crop yield gains.

Overlap Reduction

Many W.A. farmers are now alert to reducing overlap in relation to herbicide applications. However, what about seeding overlap and harvesting overlap? Money and effort spent establishing accurate and permanent tramlines with matched machinery widths, achieves reduction in overlap for *all* crop inputs and machinery operating costs.

For our operation we calculated overlap reductions to be 3% with the use of one marker arm; conversion to 'up and back' working saved another 3%; and auto-steering saved an additional 1%. A saving of 7% on total variable input costs was achieved, and worth at least $9,000 per 1,000ha of crop - annually. The adoption of straight line 'up and back' method of farming has been slow to be adopted in W.A. with the traditional method being to work around in circles within the field.

Simpler Navigation

A straight, permanent and visual guidance line *on the ground* (various forms exist) is easier to follow than an arrow on a computer screen (GPS) and can be used by *any* vehicle *any* time of the day, such as at nighttime and in thick stubble. Straight-line work is simpler for casual staff to find their way around fields. Straight lines are easier on machinery wear and tear as all turning is done with the tines/discs/press-wheels out of the ground. Longer straight runs equate to more efficient operating.

Soil Compaction and other agronomics advantages

The soil structure within the root zone is improved as a result of less trafficking. In time we hope to be able to reduce our tractor horsepower requirements, due to the better traction of the wheels pulling from the harder ground in the tramline row. The balance of the field never trafficked is also getting softer. Intensive fuel monitoring on our two tractors has showed a 15% reduction in fuel usage only 12 months after the establishment of the controlled traffic system.

Many people still feel that soil compaction is not a significant problem in W.A. and other soil types. Naturally yield gains from controlling traffic will vary between soil types and farming systems. Research conducted by the Department of Agriculture in W.A. suggests that there could be an average 10% yield gain across all W.A. soil types. We will carry out scientific trials on our farm this

year to attempt to quantify this - at least for our soils. The overlap savings and simpler navigation will pay for our tramline system within the short term. Any yield gain achieved as a result of reduced soil compaction will be a significant bonus to our business.

Challenges and Costs

Machine width matching is essential to make this farming system work. As each machinery item is upgraded over time farmers should act in accordance to a plan for matching widths. Machinery wheel spacing modifications will be necessary for some machines. Machinery manufacturers are beginning to issue a warranty for wider (3m) wheel settings.

The purchase cost of guidance such as marker arms, high accuracy Auto-steer or paying a contractor to carry out the initial marking must also be netted off against the gains.

Precision Planting

Due to the repeatable high accuracy of the Beeline® Technologies Steering Assist™, and the controlled traffic style of farming, we have the ability to plant our crops immediately adjacent to the previous season's furrows; a very innovative practice in broad acre agriculture. Our row spacing is 25cms and the accuracy of the steering device is approx. 5cms. The advantage of this precision is first and obviously the ability of the tynes on our planting machine to pass between the thick rows of stubble from the previous crop. This also allows the previous stubble to be left standing for maximum seedling protection. In our continuous cropping, no stock, no tillage system the ridging between crop rows (furrows) is still present from one year to the next. These furrows have the ability to harvest water into the crop row. Planting adjacent to these old furrows allows us to capture a greater than fair share of available water in our marginal moisture planting situations. Also the plant roots can better access residual fertilizer, especially immobile nutrients left from previous crops. We have attempted to do this in 2003 from our straight rows planted in 2002, and are conducting scientific trials to attempt to quantify this gain.

Shielded Spraying

Shielded spraying is the application of a knockdown herbicide sprayed inside a plastic shield or hood that is guided between each row of crop. We plant straight rows of crop with auto-steering and then guide the shields down between those same rows with a purpose built sprayer some months later. This allows all weeds growing in the inter-row zone to be sprayed with a cheaper knockdown herbicide, rather than relying on more expensive and selective herbicides as would be applied in a blanket application. Savings of approx. $30/ha on post emergence herbicides is being achieved, whilst providing an alternative method of controlling weeds developing resistance to selective herbicides, especially annual ryegrass. Our machine is currently working well with a 40cms wide shield passing between 50cms rows of lupin crop. As our confidence grows with this technology we aim to include canola and faba bean crops. The cost savings and agronomic advantages are considerable.

Band Spraying

The high accuracy auto-steering gives us the opportunity to reliably apply treatments only over the row of crop rather than as a blanked application. Expensive applications such as fungicides are not wasted on the bare ground in-between the rows of crop. In some cases this allows the use of only one third of the chemical of an equivalent blanket application. Significant financial and environmental savings can be achieved.

Staff Management

The use of the Beeline® Technologies Steering Assist™ devices on the tractors and harvesters has had positive implications for our staff management. The elimination of human error (at least for steering) means that machine placement is guaranteed. All casual operators regardless of experience effectively become precise operators. We greatly underestimate the reduction in operator fatigue as a result of eliminating their need to concentrate on steering. Our operators continually comment on how they are not so tired at the end of their twelve-hour shifts.

Importantly the operator's time is freed up to allow more effective monitoring of other machine functions. Operators are more effective at checking product application rates, calculating areas covered, scheduling of the next re-fill/unload, monitoring for blockages/breakages and so on. In the case of harvesting the more intense monitoring of the thrashing system allows for increased machine capacity in terms of tonnes of grain thrashed per hour, significantly increasing the cost effectiveness of the machine. With the automatic steering system fitted we estimate at least a 5% increase in our harvester's capacity.

Our farming system is characteristic of requiring highly skilled casual staff for concentrated periods during planting and harvesting. The rural population dynamics of WA does not allow a locally available pool of casual staff. Hence we rely on itinerant staff often with limited agricultural experience. We would previously seek operators with prior tractor operating experience, and now as a result of partial machine automation find ourselves employing from a broader pool. This includes many interested and capable people, who are keen to participate in agriculture at the innovative end, who would previously have been unacceptable on the basis of lack of experience.

Application of Precision Farming

We are very focused on profitability management across all areas of our farm. Through yield mapping we have identified significant variation in yields and in turn profit across the range of soil types within our fields. This has highlighted the need to work with all available technology and processes by which to understand this variability. Unlike some approaches to Precision Agriculture (PA) ours has been to maximize profits on each part of the fields, rather than attempting to create a uniform yield from one side to the other.

We have yield mapped all of our crops for the past three harvests; we wish that we could have started ten years ago. We have purchased crop biomass imagery taken from satellites during late spring in each of the past eight years covering the whole of our farm. These crop biomass images correlate favorably with our yield maps due to our low historical incidence of frost damage. Additionally we have mapped our whole farm for elevation on a 9m grid with an accuracy of +/-10cms to create a digital elevation map.

The yield maps, and separately the biomass images, are overlaid and analyzed to identify areas that are 20% above or below the mean production, as well as identifying areas that perform consistently within the same productivity range over the range of years. These summary or combined images of each field provide the basis for further investigation of factors limiting yield and variations to profit. The digital elevation map is useful on its own for contour and drainage planning. However, when overlaid to the yield and biomass images it allows them to be seen as three-dimensional (3D) images, further highlighting where each productivity zone fits into the overall landscape.

We have changed the way that we approach our soil sampling as a result of the availability of this information. As distinct to our previous random sampling approach, our soil samples are now targeted within productivity zones. It might be expected that the soil in the higher yielding zones would show a higher nutritional status and the low productivity zones a lower available nutrition level. The opposite seems to be the case. Why, in the higher productivity zones the crop has been removing a higher than proportionate level of nutrients than the blanket rate as applied each year, consequently we are effectively mining the nutrition in those areas. Alternatively nutrition is accumulating in the low productivity zones due to lower removal rates. This further highlights the opportunity to vary inputs in relation to productivity zones. The water holding capacity of the soil explains much of our yield variation between productivity zones.

With the assistance of consultant agronomist advisers and nutritional experts we have been field by field and productivity zone by zone to firstly identify the factor(s) limiting yield, then identifying an optimum yield for that zone. Finally a profit maximizing level of nutrition for that zone is decided. An increased need for specialist Precision Agriculture advisors is foreseeable.

Profits by yield zone are calculated in a detailed spreadsheet. We have varied our application rates of Lime, Gypsum, Nitrogen(N) and Potassium(K) for the past three years. An example is that the best 15% of the farm's productivity zones gets double the Nitrogen to that of the standard. At the same time the worst yielding 7% of the farm is no longer cropped.

In the coming year we will be involved with a research project to explore the use of EM38 and airborne radio-metrics to obtain better soil type mapping and zone identification. We would also like to gain a greater understanding of where we are situated on local response curves for N, P, & K at each yield range. It is our goal for 2004 to use electronic variable rate application systems to automatically vary the three fertilizer products applied at sowing time.

Biographical

Educated with a Bachelor of Business (Agriculture) First Class Honours Degree, Glenn spent five years working in Sydney as a Domestic and International Commodities Trader responsible for trading, processing and price risk management for a range of oilseed commodities. Returning to manage the family's farm in 2000, Glenn's management skills and community involvement are apparent through hosting farm field days, coordinating a local grower discussion group, contributing to agricultural conferences and as a Director of his old University the Muresk Institute, a Division of Curtin University.