Unique approach to mallee harvester design

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ABOVE: Well designed plantings within farms will increase the efficiency and economy of the oil mallee industry when a suitable harvester is available. (Photo: Ben White)

Future Farm Industries CRC (FFI CRC) has appointed Queensland company, Biosystems Engineering, to design and manufacture a prototype mallee harvester. FFI CRC CEO Kevin Goss believes the appointment of the specialist engineering company is the clearest sign yet the commercial viability of the oil mallee industry is close to being realised.

"Mallee trees planted on Western Australian wheatbelt farms for more than two decades have now gained recognition as a cheap and clean energy resource, that regrow after harvesting, for electricity production and more recently as carbon sinks," Kevin said.

"Interest in mallees is expected to increase as farmers continue to look for new income sources in a drying climate – particularly incomes that have complementary on-farm environmental benefits.

"FFI CRC will make mallees more profitable for farmers with the aim to develop the world's most efficient biomass harvester and have it commercially available from as early as 2011."

"The appointment of Biosystems Engineering is part of a $1.5 million Low Emission Energy Development (LEED) funding agreement with the WA Government to develop a fully commercial harvester able to convert standing mallees into chipped biomass."

"Biosystems Engineering is an Australian company with recognised specialist expertise in development of innovative technology within the agricultural, water and energy sectors with an emphasis on generating commercial outcomes," Kevin said.

"Through this appointment they are now responsible for the design, fabrication and field testing of a new prototype mallee harvester."

Biosystems Engineering Principal Engineer, Richard Sulman is driving the design and development of the new harvester.

key points

- Engineering company *Biosystem Engineering* is taking a practical approach to the oil mallee harvester challenge
- Assessment sites have been established in Western Australia, South Australia and New South Wales
- A key focus in current research is to expand the range of commercially-available cultivars to support producers across different geographical areas.

Design background

The original prototype oil mallee harvester was developed in WA during the late 1990s and early 2000s with major input from well known WA machinery developer, Dumbleyung Engineering's Harley Pedderick.

Using some components from a sugar cane harvester purchased by growers, this machine revealed that a commercial harvester was needed to process a single-row of upright trees cut close to the ground and then chipped in a continuous manner.

Richard has combined the advice of industry experts such as Rick Giles and John Bartle, both from the WA Department of Environment and Conservation (DEC), with his own practical experience. He is driven by the basic engineering principles of harvesting a woody crop in a manner different from traditional forestry methods.

"I don't think of the mallee as a tree, I think of it as a big forage crop that lies between thin-stemmed crops such as sugar cane or coppice willow and conventional forest plantation trees.

"With this view, it is our job to develop a machine targeted at handling this crop in the most efficient way.

"Our design will derive its inspiration from both forestry and agricultural principles in biomass handling and processing."

LEFT: Biosystems Engineering, Principal Engineer, Richard Sulman's design will derive its inspiration from both forestry and agricultural principles (Photo: Ben White)

Efficient supply chain

Biosystems Engineering is trying to achieve the world's most efficient harvester for mallee trees as part an overall supply chain system being managed by the FFI CRC.

"To come up with a new and innovative prototype we first need to understand the mallee tree in terms of its unique size, shape, positional layout within an existing farming system, feedstock location across the WA wheatbelt, and ultimately, its market value in a chipped biomass form," Richard said.

"The mallee industry needs a harvester and supply chain system that will make the mallee feedstock an economically competitive resource.

"Given the existing challenges facing the biomass market and the dispersed location of current mallee feedstock across the WA wheatbelt, creating a viable harvester and supply chain system could be a challenge.

In his bid to get a greater understanding of the industry, Richard has worked closely with Rick Giles. Rick has been involved with harvesting options for the industry for more than a decade (see *Focus on Perennials* Issue 1).

"Rick suggests the supply chain accounts for about 70 per cent of the total biomass cost," Richard said.

"Out of that, it is understood that the cost is split equally between harvesting, in-field transport and road transport.

"Given the significant cost of harvesting and in-field transport attributed to the total biomass cost, finding an efficient solution quickly is vital to build a commercially viable mallee industry."

Dr Amir Abadi, FFI CRC economist (DEC) has investigated the economic and commercial viability of the oil mallee industry.

Dr Abadi suggests that although Biosystems Engineering engineers have their work cut out for them, when the industry reaches commercial capacity the challenges won't be insurmountable.

"Initial plantings were for a variety of purposes including research," Dr Abadi said.

"When the industry is commercially set up, there will be well-designed plantings within farms and regions.

"This will ensure efficiencies due to contiguous plantings and economies of scale."

Developing the prototype

Richard wants to get a prototype (P1) out as early as possible, not just to test the principles of continuous harvesting, but to determine potential efficiency gains early on before further investment is made to develop a commercial size harvester by 2011.

"In order to fast-track the prototype process and to keep up with industry expectations, we undertook a study into existing suitable platform vehicles, allowing us to invest more money and time into designing a prototype harvester head that can be demonstrated to the public by mid 2010," Richard said.

"We've studied various methods to power and drive the harvester, looking at everything from front-end loaders to forage harvesters and utility tractors."

Based on this study, Richard has chosen a utility tractor — the Claas Xerion (pictured). He will not need to modify this tractor, allowing him to focus on developing a standard implement attachment (harvester head), which will go onto a category-three hitch.

"We are aiming to develop a harvesting machine that can process about 100,000 tonnes per year but first we need to study a smaller prototype to understand where efficiency gains can be made."

He plans to have the prototype ready and operating in the WA wheatbelt by March 2010.

More information

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Student delves deeper into perennial wheat roots

As the research into suitable perennial wheat options for Australian conditions continues to progress, Charles Sturt University PhD student Nicole Hyde (pictured right) is taking a deeper look into what might happen beneath the soil surface.

"As part of the overall investigations I am focusing on the plants' root systems and looking at how they allocate their resources between above- and below-ground biomass," Nicole explained.

"Because, as perennials, these accessions grow for longer than their annual counterparts, we expect them to have much deeper root systems."

Nicole will also investigate the link between root activity and grain yield and quality.

Nicole started her PhD during September 2008 and due to limited seed availability to date, is containing her studies to pot trials this year.

"At this stage, I will focus on the affects of various nutrient and water applications," Nicole said.

Next year, Nicole hopes to take her studies into the field with the help of a rhizo-lysimeter.

"The rhizo-lysimeter will allow me to take accurate measurements of root growth and water use across different seasons," Nicole said.

In-field trials at Cowra, New South Wales (see *Focus on Perennials* Issue 4) will continue this year.

More information

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