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JIVET & DNA supercharge sheep breeding at Leahcim

Andrew Michael has taken sheep breeding beyond the cutting edge and into new territory, with a new program that is super-charging the speed of genetic gain in his flock.

Known as JIVET – juvenile in vitro embryo transfer – the program has already delivered stud lambs years in advance of those from his conventionally joined flock, thanks to a combination of old-school visual appraisal and traditional measurement techniques, with the latest in DNA testing and embryo collection methods.

Put simply, the program identifies superior breeding stock at a very early age (within weeks of birth); uses advanced embryo technology to collect eggs from ewe lambs at approximately six to eight weeks of age; joining then occurs in a test tube before the lambs are carried to term in surrogate mothers.

While traditional breeding methods mean that most ewes are not joined until 18 months of age, the JIVET method is delivering the first drop of lambs using genetics from elite ewe lambs six months after the birth of those lambs.

What is JIVET?

- JIVET stands for Juvenile In Vitro Embryo Transfer
- Lambs DNA tested at 1 week of age
- Based on DNA test results, ASBVs and pedigree – prepare breeding plan
- Embryos are harvested from ewe lambs at 6-10 weeks of age – no long term impacts on natural reproductive performance
- Eggs and semen from top ram lambs are fertilised in vitro then carried to term by recipient commercial ewes
- In the space of six months a new drop of high performance lambs are on the ground – traditional breeding methods would have taken up to 2 years

“For the first time we can do rapid genetic evaluation and do it very accurately, and this dramatically shortens the genetic intervals,” Mr Michael said.

“The dollar returns are staggering – we estimate the superior genetics will deliver an \$8 increase in returns from every ewe lamb every year compared to a figure of just over \$2/ewe per year for our conventional program.”

Mr Michael runs the Leahcim White Suffolk and Poll Merino studs, based at Snowtown, South Australia.

The Michael family runs about 3000 stud ewes – 2000 Poll Merino and 1000 White Suffolk – as well as 600 commercial Poll Merino ewes. The flocks are on three properties: at Snowtown (where all performance recording is conducted), another in the south east of SA (a breeding block where the pedigree recording is conducted), and a third in the Pastoral Zone (where young animals are grown out).

Operating on country varying from deep sands through to rolling undulations, and in rainfall patterns ranging from 200mm a year to 500mm, Mr Michael said the key to breeding sheep that can perform in these different environments and deliver against the profit drivers for his business, was to understand their genetic make-up.

He has done this through 30-plus years of data collection for Australian Sheep Breeding Values (ASBVs), and more recently through the Cooperative Research Centre for Sheep Industry Innovation (Sheep CRC) DNA testing programs. The Sheep CRC's DNA tests have allowed him to identify “hard to measure” genetic traits such as meat eating quality or, in the case of his Poll Merino flock, identifying carriers of the horn gene.



An Australian Government Initiative



“Understanding fat and muscle traits are also important because I want to transform the Merino to being an animal that can perform in every environment, as well as being more productive in terms of fleece weight, wool production and number of lambs weaned,” Mr Michael said.

“Things like intra-muscular fat and shear force are also traits we look for because if we can get our eating quality right then it’s icing on the cake.

“The other major benefit that genomics has delivered for us is that we can make breeding decisions much earlier and with a lot of confidence. Before we even scan the rams, we have an idea of what genetic groups they should go into and what these rams can offer in terms of hard to measure traits.”

Now, in the JIVET program, Mr Michael is using the technology to make those selection decisions even earlier, leapfrogging his leading stud sheep years into the future.

How JIVET works

The JIVET program was implemented with assistance from the Sheep CRC and SHEEP GENETICS, with design support from Greg Popplewell, of Total Genetic Resource Management, and Stephen Lee, of the University of Adelaide.

To start the program Mr Michael selected his 10 best stud ewes for an embryo transfer program, with semen used from his DNA tested ram lambs, resulting a drop of 43 elite lambs born on 1 April 2013.

These lambs were DNA tested at one week of age and, using this DNA data in combination with ASBVs and pedigree information, the best 10 ewe lambs were selected for embryo collection at eight weeks of age.

At the critical 6-12 week period in the young ewes’ development, embryo production is super-charged, allowing for the safe collection of high numbers of good quality eggs – in this instance a total of 465 eggs were collected from the 10 ewe lambs.

While the ewe lambs went back to the rest of the stud flock to grow out for a life of normal breeding, their eggs were sent on to SARDI’s Turretfield Research Centre for quality analysis and test tube fertilisation, before placement into recipient commercial ewes.

JIVET Timeline

Nov 12 - ET older ewes

April 13 - lambs born and DNA tested at one week

June 13 - eggs collected from donor ewe lambs

Nov 13 - JIVET progeny born and DNA tested at one week

Nov 13 - eggs collected from donor ewe lambs

Dec 13 - IV fertilisation of eggs to coincide with joining of the rest of the stud flock

These recipient ewes were selected well in advance so that their ovulation could be synchronised with the juvenile donor ewes.

The high number of eggs allowed Mr Michael to make multiple crosses with each of these ewes, rapidly diversifying the genetic mixture while at the same time accelerating the rate of genetic improvement in the flock. Born in the first week of November, this drop of JIVET lambs delivered 25 ewe and 25 ram lambs from 14 different genetic crosses.

Mr Michael said that within two weeks of being born the lambs were already expressing muscle patterns that he had not encountered before in his flock and were the rival to the best British breed stock he had seen.

“There’s not one lamb there with too much skin, and we know from their ASBVs that they should be brilliant for fleece weight and

muscling, and they are visually outstanding as well,” he said. “I’m really looking forward to seeing how these lambs perform as I’m confident they will verify the accuracy of the ASBV and DNA data that we’ve used in selection.”

And from the original 10 ewes selected for the first JIVET program, Leahcim now has 30 different genetic crosses available for future selection, all within the space of 12 months – a feat which would have taken another three years to achieve using conventional breeding.

The genetic gains are set to multiply incrementally, with the next JIVET program already underway.

“We have already sent blood samples away for DNA testing so that we draw eggs from the best ewe lambs when we begin our next program when they are six weeks old,” he said.

The next joining will occur in line with the remainder of his naturally joined stud flock, allowing for benchmarked, real-time comparisons for growth and performance.

“By April 2015 we should have phenotypic data from the full group of JIVET and non-JIVET lambs which shows a distinct difference in productivity between the two groups due to the acceleration of genetic gain in the JIVET lambs,” he said.

While the first JIVET took a total of 10-13 weeks to complete, Mr Michael anticipates this could be reduced to just four to six weeks as DNA testing and in vitro fertilisation processes improve.

“We need to make this breeding technology a winner so that we can pass on faster rates of genetic gain to mainstream producers so that they can also make major advancements in a very short space of time.”

- More information and video from the JIVET program is available at www.sheepcrc.org.au.

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Captions: Lambs from Leahcim’s JIVET program.

: Leahcim stud principal Andrew Michael.

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