

Genetics a frontline weapon in war on Johne's

■ by Mike Bradstock

The unique genetic resource of Peel Forest Estate has enabled new research at AgResearch Invermay and the University of Otago to demonstrate for the first time a clear hereditary basis to Johne's disease (JD) resistance and susceptibility.

The landmark study, funded by the Johne's Disease Research Consortium, is headed by Colin Mackintosh of AgResearch Invermay and reported in a recent paper¹ based on a study using Peel Forest Estate deer known to have a range of resilience to JD.

Graham Carr, of Peel Forest Estate Red Deer Genetics, is excited about the results, which he says provide independent confirmation of the merits of his B11 terminal sires and Peel Forest maternal sires, which are becoming well known throughout the industry for their JD resilience. He told *Deer Industry News* that he's taking further action to consolidate the position of his herd genetics as the premium resource in the fight against JD.

Greater understanding will pave way for progress

While Mackintosh cautions that the research does not promise any quick-fix solutions he says that increased understanding of the genetic basis of JD resistance – and identification of genetic characters associated with it – will help pave the way to breeding greater JD resistance. Meanwhile, he agrees that wider dispersal of the Peel Forest genes will help notch up JD resistance in the national herd.

"We have over a number of years been working with Dr Frank Griffin in analysing our herd and the breed influence on the susceptibility or resilience of each breed and within each bloodline to produce a mass of breeding values for JD within the Peel Forest herd," Carr says. "This has enabled us to finely tune our own breeding programme to breed sires for the industry that still maintain good productivity results while combating the debilitating effects of JD. This latest trial shows how important these animals are, as we know this characteristic is heritable – a huge advantage.

"The findings have given us the confidence to undergo a basic change of direction in our stud operation. We have been focusing strongly on breeding for JD resilience while at the same time maintaining our breeding programme for world-class trophy and velvet genetics. Ironically perhaps, we are in a strong position to do this because in the past all animals on our property have experienced heavy challenge with JD and that has given us an ideal 'laboratory' in which to experiment with developing JD resistance.

"Recently we have leased a neighbouring property with the capacity to run a further 1000 hinds in an intensified operation to produce more B11s and maternal sires with JD



Graham Carr: Excited by the genetic progress made against Johne's disease.

resistance and make them available at moderate prices to the benefit of the whole deer industry. We will be doing our best to build up numbers as quickly as possible and further build their JD resilience by rigorous selective breeding."

Selecting for a range of traits

Peel Forest occupies a unique position to select simultaneously for a range of desirable characteristics, including JD resilience, which has not been possible in the past, Carr says. "Over 12 years we have consistently produced large groups of related animals of known parentage, by making extensive use of embryo transfer and AI and using genetic-marker-assisted parentage testing with all offspring. Records cover more than 5000 deer classified by, among other parameters, their susceptibility or resilience to JD.

The experiment

In the experiment, 24 *Paralisa*TM-negative hinds were inseminated with semen: 12 by a known resilient (R) sire from Peel Forest and 12 by a known susceptible (S) sire from Peel Forest. The resulting nine fawns from each sire were challenged with a heavy dose of MAP (Johne's) bacteria when they were four months old and closely monitored for the following 11 months. Clinical Johne's disease developed in three offspring (two S and one R) and these were euthanased. The surviving progeny were slaughtered 11 months after challenge. Seven out of nine progeny of the R sire became *Paralisa*-test-negative and one had become completely clear of the infection. Among the S progeny, eight out of nine remained highly *Paralisa*-test-positive.

According to Colin Mackintosh's paper, "The offspring of the S sire were significantly more severely affected than those of the R sire ... Most of the resistant, but not the susceptible, animals showed evidence of resolving lesions and a reduction in the number of MAP between 13 and 49 weeks after challenge."

Among the surviving males there was a 10-kg average difference in weight gain between resistant and susceptible animals. The paper went on to say, "The five male R offspring gained significantly more weight on average than the nine S offspring over the 49-week study (70.3kg versus 59.8kg) despite being 2.8kg lighter at the start." This difference was statistically significant, and even more impressive because the susceptible sire had a higher breeding value for 12-month growth weight owing to its genetic makeup.

¹ Mackintosh, CG, et al (2011) Immunological and pathological responses of red deer resistant or susceptible genotypes, to experimental challenge with *Mycobacterium avium* subsp. *paratuberculosis*. *Vet. Immunol. Immunopathol.* 143: 131-142.

“This latest work vindicates the way we have handled our history of JD. Back in 2001 we recognised that we needed to come to terms with the disease to better the future of the seven bloodlines we had carefully built up.

“We had to accept that although vaccination worked in the short term, it was not acceptable in a breeding operation where we needed to confront the disease. Since then our breeding programmes have been directed at demonstrating and consolidating genetic resilience. This is the direction in which we will continue.”

Together with Peel Forest Estate farm manager, Steve Blanchard, Carr has put a lot of time into visiting and talking with farmers to help them develop a simple foolproof system to increase productivity. “We moved away from trying to produce dual-purpose sire stags in order to following the well proven track of the sheep and beef farmers, by encouraging use of a dedicated maternal sire for hardy, fertile replacements and a dedicated terminal sire for healthy growth rates.

“Just as it’s Romney and Suffolk for sheep, or Angus and Charolais for cattle, so it’s the maternal and B11 for deer. It’s the KISS principle. Add JD resilience into the mix and you have a very simple, highly effective system to sustainably increase productivity and combat JD.”

Meat quality effects

The effect of JD on meat quality was another issue for further study, he says. “With a muscle-wasting disease like JD, meat quality as well as quantity can be affected and we plan to work with processors to analyse the yield and meat quality from resilient progeny.

“But this is much more than a production issue in deer farming: it’s also a wider animal health and welfare issue. Colin and his team have conclusively demonstrated for the first time a genetic basis to extremes of susceptibility and resilience to JD in ruminants. It’s groundbreaking work that also offers enormous benefits across the whole farming industry, and we are very proud to be associated with it.”

Immunologist Frank Griffin, of Otago University, who is one of the paper’s authors, is cautiously upbeat about the results: “The work showed that a single sire can have a large impact on the resistance or susceptibility of its progeny. The bigger question is the level of heritability that may be perpetuated in crossbred animals.

“Unfortunately we have no genetic marker test to identify highly susceptible animals. Increasing immunity depends on crossing known resistant sires over less resistant hinds to increase the overall resistance of the offspring. It’s a question of being able to make the herd more resistant overall, rather than being able to actively remove susceptible animals from the overall gene pool by culling.”

The scientists agree that a two-step selective breeding process offers the most effective way that can be immediately implemented with infected herds. This entails first, using the Paralisa™ test to identify and cull high-antibody-positive animals (which are likely to have high susceptibility) and second, crossing known resilient sires with Paralisa-negative hinds.

Carr said that apart from JD resilience, the B11 terminal sires also had other desirable qualities including high libido,

Shed nearly ready

Following the loss of Peel Forest’s deer-handing shed in a fire last May (see *Deer Industry News*, June/July 2011, page 43), a new building is under construction and will be ready just in time for the velvetting season, says Graham Carr.

The new shed, measuring 29 by 18 metres, is designed for maximum ease of stock handling and minimal stress on the animals, a crucial issue in a complex deer farming operation with many stud animals that have to be handled more frequently than production animals. As a result, all floors in the shed are surfaced with rubber matting. “This should help particularly with animal welfare issues such as foot health – for example fusiformis can be a big problem here – and reduce injury when velvetting.”

Recognising that velvet is a food product, particular attention has also been paid to hygiene. The shed has been designed for ease of cleaning and has high-pressure hoses and walk-in freezers.

The shed has also been fitted throughout with the latest EID equipment from Gallagher, which not only ensures NAIT readiness but also will facilitate the continuation and even expansion of herd data recording. Bar code printers for labelling lab test samples will help eliminate human error and streamline handling. A custom-designed crush and an automatic electronic weighing and drafting crate is being installed by Farmquip.



The new shed at Peel Forest is almost complete.

early rutting and hardier, more consistent progeny with impressive growth rates. The maternal sires are rigorously selected for constitution, temperament, fertility, growth rates and velvet genetics. “The female side of any livestock breeding programme has the greatest influence on the outcome and again, JD resilience in these bloodlines offers great promise in the fight against this pernicious disease.

“The fact that it’s often the high-production animals that are more susceptible to JD highlights the importance of coming to grips with the problem. It’s crucial to understand that Johne’s has a strong genetic base, and that both resilience *and* susceptibility are strongly heritable. Selective breeding offers real promise in the fight against JD in deer.” 📺