

Breeding like rabbits

Advanced genetic technologies are being used to help farmers diversify into rabbit production. **Wendy Pyper** outlines the strategy to raise rabbit fertility.

Photo by Wendy Pyper



Rabbits have played a significant yet controversial role in Australian history since their introduction by European settlers in the 1820s. Their speed and sheer numbers have made them a popular target of hunters, their pelts have contributed to a fur industry, and during the depression in the 1930s, 'underground mutton' saved many families from starvation. The destruction rabbits wreak on our native flora and fauna, however, has prompted efforts to remove this environmental menace from the country.

Since the 1930s, CSIRO has been at the forefront of research into myxomatosis, rabbit calicivirus and immuno-contraceptive mechanisms, all aimed at eliminating rabbits. While this work continues, CSIRO has recently turned its interest towards a new area of rabbit research that, in a complete contrast to previous work, hinges on the ability of rabbits to breed like rabbits.

The setting is New England in northern New South Wales, a region renowned for its Scottish heritage, elegant architecture,

Above left: These newborn kittens are blind, devoid of fur and weigh less than 100 grams, but in the next six days they will double their weight and grow fur. The kittens open their eyes between seven and 10 days and start jumping out of the nest box on about day 14. **Left:** Eighteen-week-old kittens.



spectacular waterfalls and tales of Thunderbolt, the 'gentleman bushranger'. As any drive through the picturesque countryside will reveal, New England is also a major beef and sheep farming region. In recent years however, farmers and other entrepreneurs in the area have turned to a new form of livestock to supplement their income . . . farmed rabbits.

Farmed rabbits are distinct from the wild rabbits that still dot the New England countryside in that they stem from breeds of rabbits that have been domesticated over hundreds of years, primarily for meat production. Farmed rabbits are also almost twice as big as wild rabbits and their meat is whiter, less gamey and free of the disease connotations imposed by myxomatosis and rabbit calicivirus.

Because of the pest status of wild rabbits, commercial rabbit farming was prohibited throughout Australia until 1987, when the ban was lifted in Western Australia. New South Wales and Victoria

then followed suit in 1995 and 1997 respectively.

Since then, meat rabbit farming has become one of Australia's fastest growing new industries, supplying a burgeoning gourmet restaurant trade. The demand for rabbit meat in Australia outstrips supply, so profitable market opportunities are available to farmers.

Unlike more established meat industries however, there has been little opportunity for selective breeding programs aimed at improving production.

Newcomers to the industry expecting to make their fortune by throwing a few rabbits together in a cage are dismayed to find that the animals don't breed like proverbial rabbits. The effects of inbreeding and unions between poor performers soon reduce litter sizes and kitten survival, while the cost of feeding and housing the animals eats away at profits.

But support for farmers to adopt advanced breeding technologies is on its

Australian farmed rabbits produce about seven litters a year. Litter sizes vary, and some kittens are born dead. However the Crusader breeding program aims to select for rabbits that produce eight to nine live kittens per litter and wean at least six of those.

way, in the form of the 'Crusader' meat rabbit breeding program. Run by scientists at the CSIRO Pastoral Research Laboratory, just south of Armidale, the program aims to selectively breed rabbits for traits that contribute most to farm income. These include bigger litters, higher rates of kitten survival and increased growth rate.

To achieve this aim, project leader Dr Sandra Eady, and her colleagues Dr Kishore Prayaga and John Smith, with funding from the Rural Industries Research Development Corporation, had first to evaluate the performance of the three major rabbit breeds available to farmers: the New Zealand White, the Californian and the Flemish Giant.

Below: The gestation period varies between 29 and 33 days. Three days before birth ('kindling') nest boxes containing suitable bedding material are placed in the cages. The doe will also pluck fur to add to the nest. Without nestboxes, kittens will be born on the cage wire and die of cold, so knowing when to include a nest box is crucial.

Bottom and below right: Kittens can be weaned between four and five weeks of age. At the CSIRO rabbitry, weaners are ear tagged and transferred to 'grower' cages where they're fed until 12 weeks of age. They are then sold into the Sydney metropolitan area as whole carcasses, though a registered rabbit processor in Tamworth.

'Our main focus was to look at differences between the three main breeds available in Australia and compare the performance of pure breeds and crosses between the three,' Eady says. 'The reason for doing the crosses is that crossbred animals often show a significant level of "hybrid vigour" (improved performance) for traits such as litter size.'

Foundation stock for the breeding program were donated by 25 different farmers as in-kind support for the new project. This provided a population that approximated an 'average' for each breed. Matings within each pure breed and between Californians and New Zealand

Whites and Flemish Giants and New Zealand Whites were then performed.

Three-way crosses between the progeny of these matings were also evaluated, maximising the opportunity for hybrid vigour to be expressed for both reproductive traits in does, and growth traits in individual rabbits.

The results of the study showed that purebred New Zealand Whites and their crosses gave superior results for reproductive traits such as litter size at birth, number of kittens born alive, and litter size at weaning.

For weight at weaning and average daily weight gain, the New Zealand White and Flemish Giant rabbits and their crosses were best. Although there was some evidence of hybrid vigour for litter traits, it was not great enough to justify a cross-breeding program.

'There is a cost in maintaining the pure breeds for generating crossbreeds. So crossing programs are only worthwhile if the pure breeds give economic levels of



production in their own right, and if crossbred rabbits produce more than either of the parent breeds,' Eady says.

At the end of the evaluation, Eady and her colleagues were left with two options. They could develop a superior line of purebred New Zealand White rabbits, or they could select the best producing rabbits from their stock, irrespective of breed, and develop a 'strain' of rabbit carrying the best genes.

'We decided that the second option was the most attractive, as it would allow us to select the very best rabbits in the base population for breeding, and ensure a greater genetic diversity that would assist in the management of inbreeding,' Eady says.

Putting a value on breeding

To select the best rabbits for the Crusader program, Eady and her colleagues rank bucks and does on an index of economic merit. This index is based on 'estimated breeding values' (EBVs) for the number of kittens weaned and high growth rate after weaning (see story on page 31). Rabbits with above average EBVs for these two traits are deemed genetically superior in terms of their economic value to the Crusader breeding program and rabbit farmers.

'Estimated breeding values are a feature of the most advanced livestock breeding programs,' Eady says. 'In the beef industry, bulls can be assigned EBVs based on yearling live weight. Sheep have EBVs for their fleece weight and wool fibre diameter. And dairy cows have EBVs for their milk yield.'

By using EBVs rather than physical appearance to select rabbits, the Crusader program ensures proper accounting for any environmental effects on the rabbits' performance. For example, rabbits from small litters are generally larger and more robust than rabbits from large litters, because there is less competition for their mothers' milk. And at 12 weeks of age, when the rabbits are segregated for either slaughter or future breeding, the effect of litter size is still apparent.

'If we selected the biggest and best looking rabbits for our program, we could be selecting rabbits from small litters,'

Dr Sandra Eady of CSIRO Livestock Industries is leading a research team applying advanced breeding technologies to improve the production efficiency of meat rabbits.



Eady explains. 'Smaller rabbits from a bigger litter could have the same genetic growth potential as big rabbits from a small litter, but we'll never see it by looking at the rabbits. So EBVs are important because they take the environmental effects out and enable us to validly compare rabbits.'

To keep track of pedigrees and EBV information, all foundation stock were ear-tagged at the start of the program and all kittens subsequently tagged at five weeks of age. Records are then maintained on

cards attached to cages and in a computer database.

Crusader now contains rabbits from 24 buck families and about 120 breeding does. Bucks are used for six weeks and the best male offspring produced during this time is chosen to replace his father.

'To reduce inbreeding, we maintain each sire family and pick the best bucks within that sire family to continue the line,' Eady says.

After a six-week stint in the breeding program, the bucks and their pedigree and

EBV details are available for sale to farmers for \$44. Farmers can also buy 12-week-old bucks with EBVs just below those of the breeding program bucks.

The best breeding does in each family are mated amongst all sire families except their own, until their reproductive potential starts to fall or they suffer from ill health. At this point they are culled. However farmers can buy 12-week-old does with EBVs slightly below those in the breeding program for \$33.

Crusader is also developing a simpler recording system for farmers, which allows sensible selection of rabbits without the need for full pedigree information and computers. This will help farmers reduce inbreeding and provide guidelines for the selection of replacement does.

'Few rabbit farmers have computers or wish to go to the lengths of keeping a fully pedigreed system. But there are useful practices that can be achieved using a card-based system to monitor doe performance and make wise selections of replacement does,' Eady says.

'For those farmers who are using computers and have pedigree information, we are providing support for them to access recording software and link their EBV evaluations to Crusader. They will then be able to compare their rabbits with ours by using some Crusader bucks – and we'll use some of their bucks – and do across-farm analyses.'

The Crusader program has already linked to one farm's breeding program, which has been running since 1996. In fact, some of the best bucks used in the Crusader program came from the Brown brother's farm.

Down on the farm

Daniel Brown and his brother, Lucas, entered rabbit farming as a way to diversify their annual income from a fine wool sheep enterprise. Five years later, 'Growtec Rabbits' supply about 3500 rabbits a year to the meat market, earning \$9.50 per grower rabbit (12 weeks old) at the farm gate.

The brothers hope to produce another 500–1100 rabbits per year from their 85–doe breeding herd. To achieve this without increasing doe numbers, they have an established breeding program that

is slowly but surely selecting for rabbits that produce and wean more kittens.

'We average about eight kittens born alive per litter and about five of those are weaned. But we want to wean seven kittens for every doe, on average. If we wean two more kittens per litter, we'll produce an extra 1100 rabbits per year,' Daniel Brown says.

The number of kittens weaned is a particularly difficult trait to improve as it is strongly influenced by the environment. Both CSIRO and Brown have found that does may produce big litters, but sometimes more than 50% of the kittens will die before weaning. Deaths result from disease, poor mothering, or poor-quality nest boxes, but there are other, as yet unknown factors at work.

'Losing kittens before they're weaned is one of the primary causes of lost profit,' Brown says. 'So we're addressing it through genetics and management.'

In terms of genetics, the brothers select their rabbits based on EBVs for number of kittens born alive per litter, average daily weight gain (grams day), and litter weight at weaning. As is done by CSIRO, these traits are combined into a single economic index.

In the future, the Browns will also include EBVs for the interval between litters ('inter-kindling interval') in their genetic evaluation.

'While does may wean large litters, they need to do so on a regular basis so as to maintain production over time,' Brown says. 'We're actively selecting does that have adequate litter size and short inter-kindling intervals, and in the future we'll include this trait in our economic index.'

In terms of management, Daniel and Lucas follow a strict hygiene routine of inspection and cleaning, to help prevent stress and disease. They are also building a mechanised conveyer belt to carry manure out of their grower rabbit shed.

In the breeding shed, a bed of earthworms underneath the cages helps break down the droppings, reducing the amount of shovelling needed. The brothers have also developed a new plastic nest box which they say improves kitten survival and is easy to clean.

Brown says these practices have helped keep their rabbitry relatively disease-free,

although disease is a challenging problem in many rabbitries. At CSIRO, scientists remain vigilant for signs of 'snuffles', caused by the *Pasteurella* bacterium, and skin abscesses also caused by *Pasteurella* or the common *Staphylococcus* bacterium. In the future, CSIRO's Crusader breeding program hopes to select rabbits with resistance to these common diseases.

Farmed rabbits are also vulnerable to myxomatosis and rabbit calicivirus. At CSIRO, a bug zapper in each shed wards off most insect carriers. However, there were two outbreaks of calicivirus before insect control was tightened.

Business sense

Farming rabbits is certainly not as easy as it may at first seem, and although the industry is expanding, farmers are still hopping in and out of business rapidly. Those that remain, tend to be people with good business sense, who are able to



Right: Daniel and Lucas Brown of Growtec Rabbits, one of the longest running and most successful rabbitries in the New England region.

Bottom and below left: As part of a plan to simplify the management of their rabbits, the Browns have developed automated feeding and watering systems. Feed in the silo is augered through pipes in the roof of the grower shed (left of bottom photo) and distributed to the feeders in each cage (below left).

The auger is run once a day until the whole delivery system is full of feed. This lasts until the next day, ensuring the grower rabbits have an unlimited supply of feed. Water in the smaller tank feeds through a dripper system into cages in both the grower and breeder (right of photo) sheds.

Below right: The Browns have also developed a nest box specifically for rabbits. The aim was to make it like a burrow and as such, the box is fully enclosed. It is manufactured from hollow profile sheeting, which is easy to clean and insulates the rabbits from extremes of temperature.

Daniel Brown says many rabbit breeders use old drench drums, which are cheap and easy to clean, but can be very cold and often leave kittens exposed to the elements. Others use wooden boxes that tend to be eaten by the rabbits and absorb moisture, which makes adequate cleaning difficult.



Lucas Brown



Developing designer diets

FEEDING rabbits is one of the biggest costs for farmers and if not done correctly, can lead to the death of young grower (5–12 week old) rabbits.

Little is known about the performance of rabbits on different diets in Australia, so the Crusader program is trialling two commercial feeds, which differ in the type and amount of fibre they contain.

Both feeds are pellets, formulated to provide the basic nutrient requirements of rabbits. They also contain fibre in the form of lucerne in one pellet and the cheaper 'mill run' (wheat husks) in the other.

'Lucerne is a good source of fibre because it's a high quality feed and it pellets well. But it's also expensive,' Dr Sandra Eady of CSIRO Livestock Industries says. 'Cheaper sources of fibre like pasture hay and oaten chaff are difficult to pellet. Mill run on the other hand does pellet, but it doesn't have the same effect in the rabbit's gut as stalkier fibres.'

Eady says both the type of fibre and different levels of fibre in a rabbit's diet affects its health, and if the balance is incorrect the animals can get 'scour', a form of diarrhoea.

'Scouring is a big problem with grower rabbits. They come off their mothers and have to adjust to being by themselves, and if the diet is not right it will cause them to scour,' she says.

Crusader is currently working with feed companies to evaluate changes in the formulation of their feed in terms of the impact on grower rabbit health.

Above left: Jim Flack feeds pellets to grower rabbits.

Left: Young rabbits at a feeder.



contain their costs and locate their rabbitry in a sensible location: close to an abattoir.

'You've got to have rabbits slaughtered at a registered abattoir, so it's no good being five hours drive from the nearest one if you are expecting to make money,' Eady says.

Well-researched venture

While Growtec Rabbits may not be the largest rabbitry in the New England region, it is certainly one of the longest running and most successful.

Part of this success is no doubt due to the experience the Brown brothers have had raising fine wool sheep, and Daniel Brown's academic interests as a scientist at the University of New England's Animal Genetics and Breeding Unit. However the brothers also put in a lot of initial groundwork to determine whether a foray into rabbit production would be profitable.

'When we first started, there wasn't a lot of local information around about breeding and raising rabbits. So we bought six does and learnt from there,' Brown says.

This learning process involved reading as much information – primarily American – as possible, talking to other rabbit farmers and scientists and conducting their own trials into feeding and management.

'We looked at the time we spent on the daily management of the rabbits, the cost of infrastructure and feed, how to feed, how much to feed and growth performance,' Brown says.

'After the first 12 months we looked at how many rabbits we were producing and balanced that against costs such as feed, generators to light the shed, and transport to the abattoir. We determined that it would be a profitable exercise, but we really didn't notice the profits until we got above 50 does.'

The brothers also spent time developing their own breeding program, after wasting money on rabbits that didn't perform.

'We believe that to be successful, you need to start with the best rabbits you can get and you need to record their performance and improve them yourself,' Brown says.

'When we started, no rabbit suppliers were able to give us any information or guarantee that their rabbits would

perform, so we started developing our own breeding program with the aim of generating rapid genetic progress.

'To do this we adopted a number of modern genetic technologies to improve the accuracy of our selection and therefore our breeding program. We're now starting to see some of the benefits as a direct result of our investment and these modern technologies.'

The Browns have kept detailed growth and breeding performance records, and pedigrees, for all the animals they've ever had. On a day-to-day basis, weights and measurements for individual rabbits are kept on cards attached to the top of cages. Importantly, this information is also transferred to a computer, which acts as a backup in case the cards are eaten. It also allows the Browns to manage all aspects of the business.

The brothers expect that more farmers will start picking up on technology as the rabbit meat industry grows, as they did in the early days of the sheep and beef industries. And while not every farmer has the ability or time to breed their own rabbits, they say Growtec and the Crusader breeding program will at least provide good stock and information for people to start or improve their rabbitry.

'The Crusader program will provide hard scientific data that will make people aware of what they can do themselves, and will stimulate them to think more about what they're doing. There are many wives tales and theories floating around the industry and the Crusader project has already disproved a number of them,' Daniel Brown says.

In the future, farmers will be able to link into the Crusader program and breeding programs on other farms, and undertake across-rabbitry evaluations. This will allow them to benchmark their rabbits – as in the sheep, beef and pig industries – so they know where they stand against other rabbitries. It will also allow them to identify the best source of good rabbits for a particular trait or index.

More about rabbit farming

Crusader Meat Rabbit Project Web Site: www.csiro.au/crusader, Growtec: Rabbits: www.skybusiness.com/growtec.

Rabbit ratings

THE Crusader breeding program values its rabbits based on an index of economic merit.

Each rabbit is assigned an 'estimated breeding value' (EBV) for two of the most economically important traits: number of kittens weaned, and growth rate after weaning.

The EBV each rabbit receives is based on their own performance and that of their parents and relatives, so accurate pedigrees and detailed productivity records are essential.

(Family history information is critical for the evaluation of the potential reproductive performance of young bucks and does that have never produced a litter.)

Each trait is also given a dollar figure, which reflects the importance of that trait to economic returns (in terms of annual returns per doe). For example, the ability of a rabbit to wean more kittens provides a greater return than having fewer rabbits that grow faster. So a greater monetary value is placed on rabbits that wean more kittens.

The final value of a rabbit to the program is calculated as follows:

Crusader Index (\$) = (EBV for number weaned by \$34) + (EBV for average daily gain by \$11).

Abstract: Rabbit farming is a new and expanding industry in Australia, but there has been little opportunity for selective breeding programs aimed at improving production. CSIRO's Crusader breeding program at Armidale in NSW aims to improve production by selectively breeding rabbits for improved reproductive and growth traits. This requires detailed recording of individual rabbit's pedigrees and 'estimated breeding values' for certain traits. Scientists are also developing a simpler strategy for farmers to select and breed better rabbits. In time, rabbits will be benchmarked across industry and scientific breeding programs.

Keywords: rabbits, rabbit farming, selective breeding programs, Crusader program, estimated breeding values (EBVs).