

The CARLA breeding value

Using genes to combat internal parasites

Reducing a major farm cost

Internal parasites are the biggest single animal health cost for farmed deer, especially in growing animals. Deer with heavy parasite burdens grow more slowly, have higher death rates and are more expensive to feed and treat.

Selecting deer on genetic merit for resistance to parasites is a very useful tool to complement drenching and grazing management as part of an integrated parasite control plan. The Deer Select breeding value (eBV) for the level of this resistance is called CARLA.

For more information about breeding values and Deer Select, refer to the 'Deer Select' *Deer Fact*.

www.deernz.org/deer-facts

How parasite resistance works

The larvae of gastrointestinal parasites and lungworm have a sheath that protects them from the environment when they are still on pasture. A few days after L3-stage larvae have been ingested by a grazing animal they shed this sheath. They then develop inside the animal into adults before reproducing.

The sheath includes an antigen, the **Car**bohydrate **L**arval **A**ntigen (CarLA). Ruminants, including deer, produce an antibody in their saliva in response to CarLA. It binds to the sheath and limits the parasite's ability to establish in the gut.

This is a very effective type of immune response. Without it, the 'downstream' immune system needs to divert energy away from growth and put it into responses to parasite infection like scouring.

Genetic merit for resistance confirmed

The ability of animals to produce the CARLA antibody is variable and moderately heritable (heritability = 0.45). This means it is possible to select animals with higher-

Key points

- Deer mount an immune response (known as CARLA) when they ingest parasite larvae from pasture.
- The level of this response in deer varies and is heritable.
- Deer with greater resistance to parasites grow bigger and faster, are less expensive to rear and are more profitable.
- Deer Select breeders can test progeny for CARLA levels. Results are corrected for local environmental conditions and used to create a CARLA eBV.
- Breeding from deer with high CARLA eBVs is another tool you can use to combat parasites as part of an integrated parasite control plan. This might eventually reduce the need for drenches.
- Commercial farmers can also CARLA test their herds. Results can't be compared between farms but they can help identify individuals within their own herd with higher or lower genetic merit for parasite resistance.

than-average resistance to internal parasites. If you breed replacements from these animals, you will permanently improve productivity in your herd.

CARLA testing of progeny was included in the 2012–2014 Deer Progeny Test and the CARLA eBV was introduced to Deer Select from 2017. At the time it was treated as a 'research' breeding value, or rBV. Nonetheless, several Deer Select



Photo: Richard Hilson

Young deer with high genetic merit for parasite resistance can grow faster, earlier

Adding CARLA to sire selection					
ID	Growth		Meat	Index	Health
	W12eBV	CWeBV	EMAceBV	Terminal	CARLAeBV
222/18	22.4	12.0	0.71	3892	63
331/18	20.2	10.6	1.36	3563	44
338/18	18.6	10.1	0.29	3341	107
55/18	17.1	9.6	0.11	3141	-18
67/18	15.2	8.3	2.00	2929	99
201/18	19.1	8.8	1.16	2864	35
763/18	15.3	8.1	0.01	2656	-12
231/18	16.6	7.9	1.18	2525	8
370/18	12.4	7.5	0.09	2479	74
201/18	16.6	7.7	-0.71	2397	-43
27/18	12.5	6.8	1.20	2327	27
55/18	11.6	6.4	1.39	2251	58
370/18	8.8	6.1	-0.18	2036	-23
172/18	11.3	5.6	0.94	1963	121
110/18	13.0	5.3	0.19	1636	76
25/18	8.8	4.8	0.03	1600	58

Example table of young wapiti bulls showing merit for Growth, Meat, Terminal Index and CARLA (see table on next page for guide to CARLA values)

breeders began doing CARLA tests in progeny and publishing CARLA breeding values in their sire sale catalogues.

In 2019, an AgResearch Invermay trial confirmed that higher CARLA levels are associated with lower parasite burdens and faster growth rates in young deer. The trial, using 251 weaned red deer, took place between weaning in March and slaughter in October. The results included:

- **Lungworm:** for every three-fold increase in CARLA levels there was a 14% drop in larval counts by April and a 50% drop by June.
- **Gastrointestinal parasites:** for every three-fold increase in CARLA levels there was an 18% drop in faecal egg counts by April and a 30% drop by June.
- **Liveweight gains:** for every three-fold increase in CARLA levels, stags gained an extra 7% and hinds 4% of liveweight between weaning and slaughter.

This trial showed that when higher carcass values, lower feed costs and faster finishing were all taken into account, the increased marginal value of high-CARLA genetics was between \$10 and nearly \$42 an animal.

With the link confirmed between higher CARLA levels and lower egg or larval counts, as well as faster growth rates, the 'research' tag for the eBV was dropped. The CARLA breeding value now has the same status as eBVs for traits such as growth rates or eye muscle area.

Using CARLA to improve herd performance

By introducing high-CARLA genetics into your deer, you will help reduce their parasite burdens and – in time – animal health costs. High-CARLA genetics will help reduce feed costs and assist animals to reach target weights more quickly.

Deer Select breeders who record for CARLA have been noting CARLA breeding values for their sale sires for several seasons and more are likely to do so. Check whether your sire breeder can provide you with CARLA eBV values for the bulls or stags they have on offer.

CARLA and integrated parasite management

Breeding genetic merit for parasite resistance into a herd will complement other established parasite management tools and help strengthen overall parasite management. It is not a substitute for, or alternative to, the tools that are already available.

These established tools include:

- Monitoring faecal egg or larval counts in autumn
- Monitoring weight gains and checking for signs of parasite infection (coughing, ill-thrift, etc)
- Judicious use of triple-combination drenches (based on veterinary advice on timing)
- Avoid drenching adult deer unless they are vulnerable (e.g. stags post-roar)
- Quarantine drench bought-in animals
- Maintain refugia (a population of drench-sensitive parasite larvae) on pasture to combat the build-

up of resistance

- Cross-graze with sheep or cattle to clean up pasture
- Manage pastures with rotational grazing and leave high residuals
- Avoid putting young stock on contaminated pasture
- Use of crops to lower exposure to parasite larvae.

By using high-CARLA animals for breeding, genetic merit for parasite resistance will be bred into your herd. As a result, their need for drenching may reduce over time.

Reduced drenching requires good nutrition, regular weighing and ongoing monitoring for signs of parasite infection. Animal health problems like yersiniosis or John's disease can be an indicator of high parasite burdens and/or poor nutrition.

For more information on best-practice internal parasite control refer to the 'Internal parasites' *Deer Fact*. www.deernz.org/deer-facts

Breeding for CARLA and growth

Invermay research showed that there are variable levels of CARLA for all levels of growth within Deer Select. This means you can choose the right growth merit genetics for your system while still getting above average CARLA eBVs.

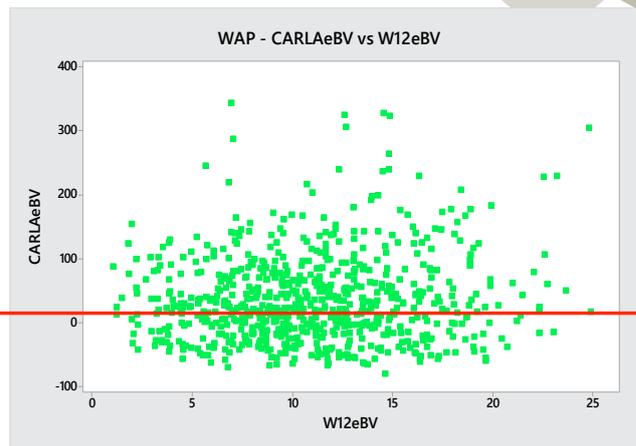
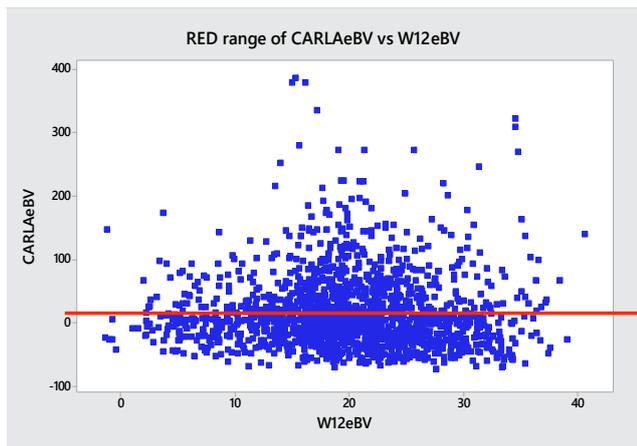
For example, you may prefer to select high-CARLA animals with moderate growth for a velvetting operation or for breeding replacement hinds.

Whatever your farm system, high merit for CARLA will help ensure traits for growth can be properly expressed, because the progeny won't be held back by heavy parasite burdens.

What Deer Select CARLA numbers mean

CARLA eBVs are available for young animal sale stags and bulls in a number of red and wapiti herds that are in Deer Select. The higher the CARLA number, the stronger and earlier the animal's immune response.

The table on the next page is a guide to merit based on CARLA values.



Genetic merit for CARLA (vertical axis) and weight at 12 months (horizontal axis) in young red (left) and wapiti deer (right) born in 2017 and 2018. This shows it is possible to select high-CARLA animals over a range of breeding values for growth to suit different production systems

Picking a good CARLA eBV		
CARLA Merit	Red – Young*	Wapiti – Young*,**
Below average	<20	<28
Average	20	28
Good	>20	>28
Very Good	>50	>60
High	100+	120+

* Red and wapiti values are not directly comparable as they are from separate evaluations

** Until mid-2020 there was no linkage between wapiti herds for CARLA eBVs, so these should be treated as within-herd values only. Cross-herd values were expected to be released in early 2021.

The CARLA test

How to test

Deer can be tested for the CARLA antibody with a simple saliva swab.

The swab is held in forceps, taken inside the cheek and held there for a few seconds until it is wet. The swab goes into a labelled vial, frozen and sent for testing. It is important to clean the forceps between swabs to avoid cross-contamination of samples.

Sampling kits are available through AgResearch and these



Photo: Jamie Ward

Taking a saliva sample for CARLA testing

contain everything you need, including instructions. Each sample costs about \$10.

Contact: carlasalivatetest@agresearch.co.nz or 0800 422 752

When to test?

Test your deer when they are being subjected to challenge from parasite larvae and their immune systems are actively responding.

The best times for this are:

1. At about 6 months of age, in late autumn
2. At about 10 months of age, in spring (the most common time for testing).

There is a strong correlation between CARLA at 6 months and CARLA at 10 months.

Animals to be tested should have been on pasture for at least a month. Don't test deer that are on crop or in hot and dry weather conditions when there will be less larval challenge and less CARLA response to measure.

Drenching: Drenching doesn't affect CARLA testing because the CARLA response is to incoming larvae from pasture, whereas drenches target established adults in the gut.



Drought is not a good time to test for CARLA because of the lack of larval challenge. The best times to test are autumn and spring, when deer are on lush pastures and their immune systems are responding to parasite larvae in their feed

How to use the test in your herd

Deer Select breeders

If you have a herd in Deer Select you can include CARLA eBVs in your sire sale catalogue. A number of studs already do this. CARLA eBVs in Deer Select herds are corrected for non-genetic effects such as birth date and mob effect. The merit of untested close relatives (dams, sires and half siblings) for the CARLA trait can also be predicted in Deer Select herds.

Deer Select red breeders can publish CARLA eBVs knowing these are comparable across herds*. This is a great advantage for buyers wanting to compare the merits of different sires across a range of studs.

*All red herds are genetically linked for CARLA and BVs can be compared across herds. For wapiti, there is increasing connectedness across herds. While not all wapiti herds are currently linked (as at November 2020), connectedness is likely to increase over time.

Commercial farmers

The CARLA eBV information provided by breeders can be used to inform your stag purchase decisions. In addition, you can get CARLA testing done in your own herd.

This can provide useful information about the range of genetic merit within your herd. For example, you might select your replacement males or females from animals that had high CARLA results when they were tested at 10 months. If you are retaining males you have bred to use as sires, their CARLA test results could help you make your selection.

But you can't compare your CARLA test results with those from other farms. Or even between different mobs run under different conditions on the one farm.

That's because the response to a CARLA test will not only be genetic. Other factors will also have an effect. Among them: time of testing, degree of parasite challenge, nutrition and maturity. Deer that are earlier born, better fed and more mature will generally show a higher CARLA response. All these factors are corrected for when a Deer Select eBV is generated.

A batch of test samples should ideally reveal a range of CARLA responses from trace to high levels. It pays to test a batch of 10–20 animals first to check if there is such a range before committing to testing all animals. If the sample shows a good range of responses, then go ahead and test the entire mob.

Mob	Sample Dating	Trait	CARLA IgA 10	Larval Protection	
Stags	16/10/19	CARLA10	133.37		High
Stags	16/10/19	CARLA10	5.499		Medium
Stags	16/10/19	CARLA10	5.196		Medium
Stags	16/10/19	CARLA10	22.883		High
Stags	16/10/19	CARLA10	102.993		High
Stags	16/10/19	CARLA10	2.835		Low

How to interpret the CARLA test

Above is an example of CARLA test results from a random herd, under the conditions that applied when the testing was done. The crucial number is in the "CARLA IgA 10" column. The animals with the higher CARLA IgA 10 values are likely to have had greater genetic merit for parasite resistance than those with lower values within that mob.

The CARLA test scale	
Result	Range
Zero	Zero
Trace	0.1 to 1.5
Low	1.5 to 3.0
Medium	3.0 to 6.0
High	>6.0

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Internal parasites



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