



## **Genetic Tests** North America



## About Us

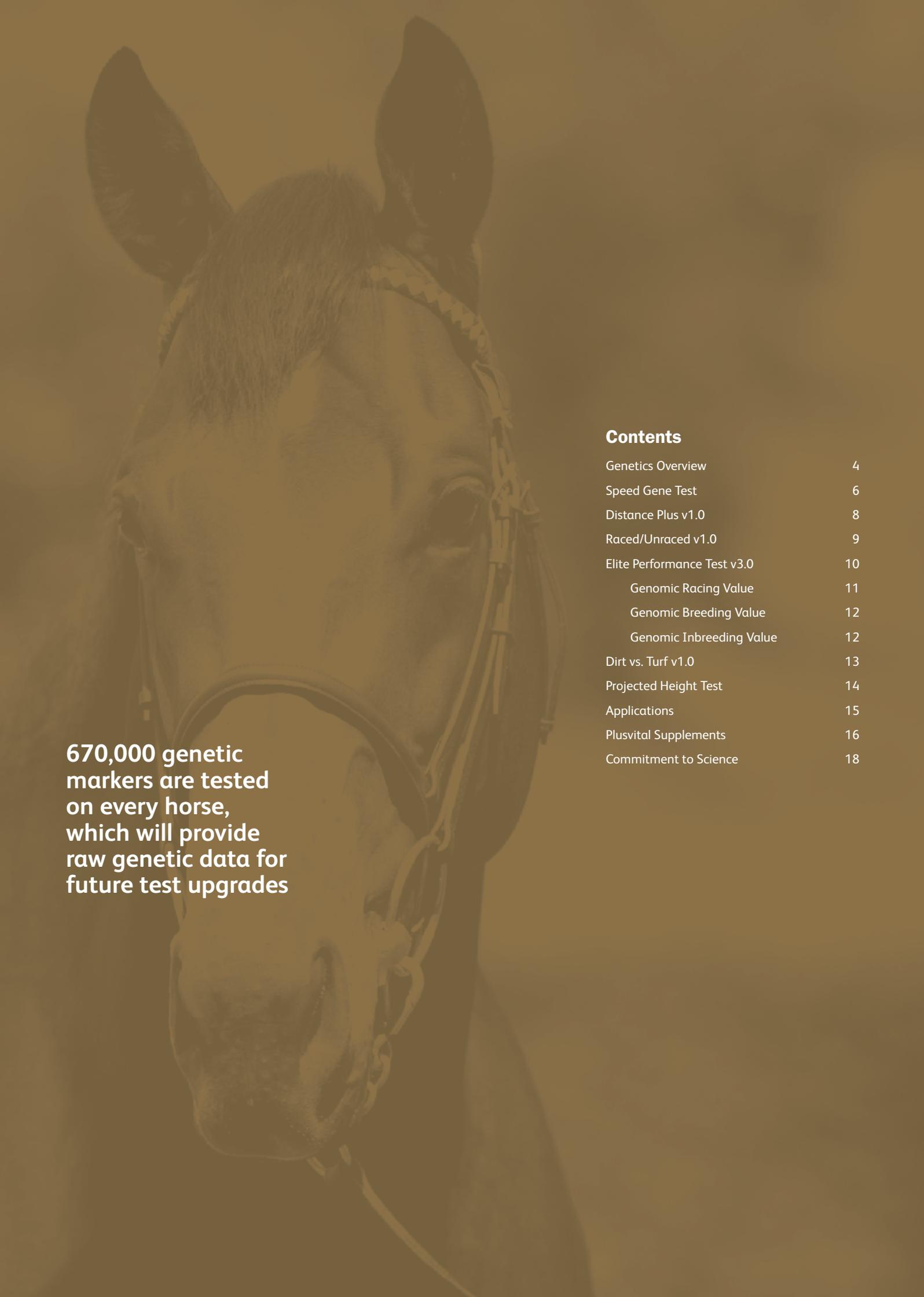
**Equinome™ was launched in 2010 as a result of ground breaking research led by Assoc. Prof. Emmeline Hill at University College Dublin, which resulted in the world's first test linking athletic performance in the Thoroughbred to a genetic marker (Equinome Speed Gene Test). Since the launch, Equinome has led the introduction of genomic testing to the Thoroughbred industry**

2015 saw new developments, with the acquisition of Equinome by Irish equine nutritional supplement company Plusvital. The vision of the newly-expanded company is the development of a world-leading equine science company that will deliver a broad range of integrated services in equine performance and health management, across the areas of nutrition and genetics and into the exciting emerging field of nutrigenomics.

We are committed to scientific excellence, with an extensive research team led by Chief Science Officer Emmeline Hill, that includes world-leading experts in molecular biology, genomics, bioinformatics, computational biology, equine exercise physiology, veterinary science, statistics and nutrition.

Our research has led to the development of eight different genomic tests, which result from analysing over 48,000 genetic markers for each Thoroughbred and providing information related to elite racing and breeding potential, precocity, distance preference, surface preference, mature height prediction and genomic inbreeding.

By 2016, over 13,000 Thoroughbred horses – including more than 1,000 black-type winners – had been tested by Equinome. Owners, trainers and breeders in all the major racing regions use the genetic information provided by Equinome tests alongside traditional methods to make crucial decisions.



**670,000 genetic markers are tested on every horse, which will provide raw genetic data for future test upgrades**

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## Genetics Overview

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**Every horse is made up of billions of cells. In each cell, the nucleus houses the genetic material. In a horse, this is packaged into 32 pairs of chromosomes – one of each pair is inherited from the dam and one from the sire**

A chromosome is a long string of DNA, made up of four building blocks referred to as A, G, T and C. The arrangement of the letters in a gene spells out the instructions to produce a protein, which contributes to an observable trait. Any slight variation in the sequence of the letters may produce differences in the trait between individuals.

In some cases, a single gene is responsible for a single trait, while other traits may be influenced by a combination of genes.

The Speed Gene Test and Projected Height Test analyze a single gene marker to determine the result. Our other more complex tests use sophisticated machine-learning modeling to analyze over 48,000 genetic markers in search of those that influence elite performance, refine optimum distance and indicate probability to race or surface preference.

While genetics can be an important factor in an individual's success, other factors such as management, training, environment and opportunity play a large role. As a result, best practice is to use our genetic tests as additional tools to complement traditional decision-making.

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“ I have been interested in genetics for some time. I believe improvements in this scientific approach should be a consideration for any serious breeder. Anything that can give the breeder an edge to potentially breed a superior racehorse should be a strong consideration.

Along with traditional consideration when making purchases or planning nominations for your mares, using genetics could give added confidence on your selections.

The decision to purchase Fountain of Youth was boosted by the result that he was C:C [on the Speed Gene Test], had a high genomic breeding value [on the Elite Performance Test v2.0] giving him a higher chance of passing on elite gene variants to his progeny. This gave me the added confidence to invest in him. ”

**Terry Holdcroft,  
Bearstone Stud**

**Every horse is analyzed on our comprehensive platform of 670,000 genetic markers, which will allow us to give our customers the most up-to-date information about their horses' genetic potential for performance when new and updated tests become available**

## Speed Gene Test

**Identify sprint, mid-distance and staying types, and precocity potential with high accuracy; breed more of your desired type of horse within one season of testing**

Best race distance and precocity potential can be predicted through the analysis of a specific marker within the *myostatin (MSTN)* gene, where the code contains either the DNA marker C or T. Each individual has two copies of the gene, one inherited from each parent, so there are three possible combinations of the genetic markers, C:C, C:T and T:T.

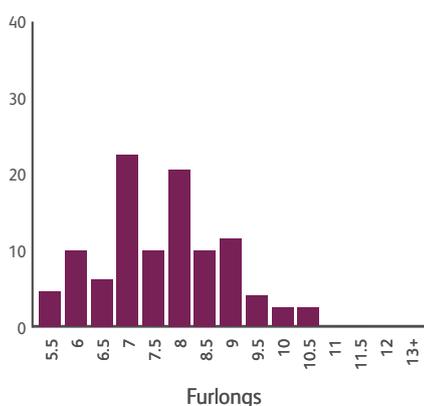
This information cannot be determined from pedigree. The mare and stallion each pass on one copy of their genetic marker (i.e. 'C' or 'T') to the foal. A C:T horse is equally likely to pass on a 'C' or 'T'. Therefore, a C:T mare bred to a C:T stallion can produce a C:C, C:T or T:T foal. This explains why full siblings can be completely different types of horse, and why race distance or precocity cannot be reliably predicted from pedigree alone.

Best Race Distance for individuals in USA only

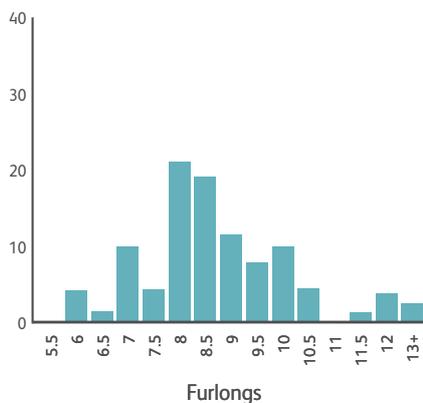
Genetic Type (MSTN gene)	Best Race Distance	Precocity	Breeding Potential
C:C	82% had best race distance of 1 mile 1/8 or less 51% had best race distance of 7.5f or less	Average age at first win: 32 months	Can only produce C:C or C:T type horses
C:T	67% had best race distance of 7-9f 20% had best race distance of 7.5f or less	Average age at first win: 35 months	Can produce C:C, C:T or T:T type horses
T:T	67% had best race distance of 1 mile 1/8 or more 38% had best race distance of 10f+	Average age at first win: 40 months	Can only produce C:T or T:T type horses

## Best Race Distance – 406 winners in USA

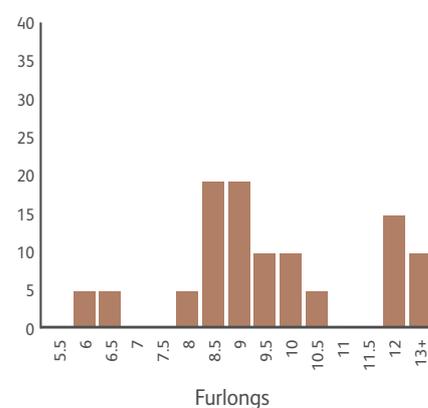
Best Race Distance: C:C



Best Race Distance: C:T



Best Race Distance: T:T



## Case Study - North America

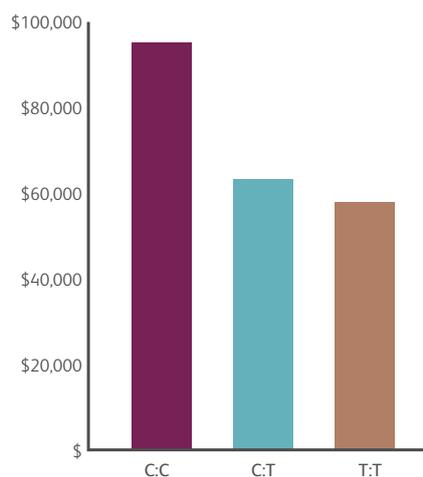
**278 horses were tested at the Midlantic Two-Year-Olds In Training Sale in May 2015. The results were kept for research and not shared with any vendors or consignors prior to the horses going through the sales ring**

Firstly, sales price was analysed against Speed Gene Type. As the gene tested is responsible for muscle development, it would be expected that C:C-type horses would command a higher price at this type of sale for early-maturing horses as they are known to build muscle quicker than C:T and T:T types.

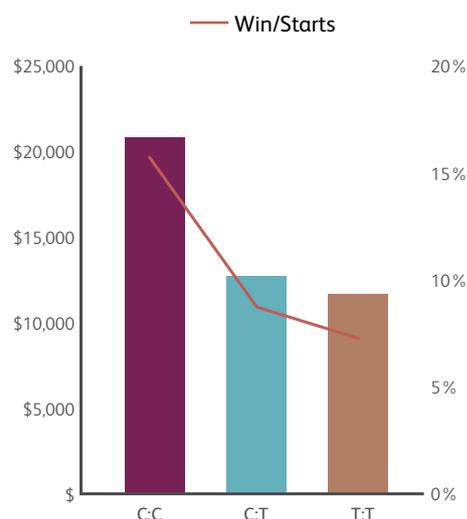
- C:C-type horses were bought for an average of \$30,989 more than C:T-types, and \$40,518 more than T:T-types.

- This demonstrates that for a two-year-old sale, there is a very significant financial benefit to vendors in testing yearlings to bring the appropriate type to this sale.
- 13% of the horses at the sale were T:T-types, which would be more suited to a different type of sale as it would be physically evident in many of them by this age that they will be later-maturing (this is less predictable at yearling stage).

Average Sales Price (US\$) - Midlantic Two Year Old In Training May 2015



Average Two-Year-Old Earnings (US\$) - and Two-Year-Old Racetrack Performance



Secondly, two-year-old racetrack performance was analysed at the end of the 2015 season to observe how the horses performed relative to their Speed Gene Type. It would be expected that C:C-types will perform better as they are earlier-maturing and also better suited to the shorter race distances that two-year-olds are limited to.

- C:C types earned on average \$8,600 per horse more as two-year-olds than C:T-types, and \$9,385 more than T:T-types.
- C:C-types had almost double the wins/starts strike rate of the T:T-types (15% vs. 8%).
- It is expected that the C:T and T:T strike rates will significantly improve as three-year-olds, but this indicates that C:C-types are superior two-year-old performers.

Speed Gene Type	% Population	Average Sales Price (US\$)	Average Two-year-old Earnings (US\$)	Two-year-old Wins/Start
C:C	41%	\$94,889	\$21,533	15%
C:T	47%	\$63,900	\$12,904	9%
T:T	13%	\$54,371	\$12,148	8%

**Distance Plus v1.0** **NEW**

**Refine optimum race distance through analysis of a more complex range of genetic markers**

The Speed Gene is the most important contributor to best race distance, accounting for almost 50% of the genetic variation on its own. However, refining the best race distance requires a more complex arrangement of genetic markers. This test adds thousands of additional genetic markers to refine the distance range prediction, separating horses into short or long C:C, C:T or T:T.

Due to different environments, racing conditions and training methods when moving from one racing region to another, we examine different genetic arrangements to predict best race distance in four of the major global racing regions. Therefore, the same horse could potentially be a “C:C-short”

in North America but a “C:C-long” in Europe due to different suitability for the different regions.

“ The introduction of genetic know-how to breeding will dramatically change the face of the bloodstock industry. We have begun and intend to continue to utilise this highly valuable tool to fine-tune decision making in our operation. This will fundamentally change the way we will have to think about breeding in the future. ”

**John O’Connor,**  
**Managing Director,**  
**Ballylinch Stud, Ireland**  
**Irish Breeder of the Year, 2014**

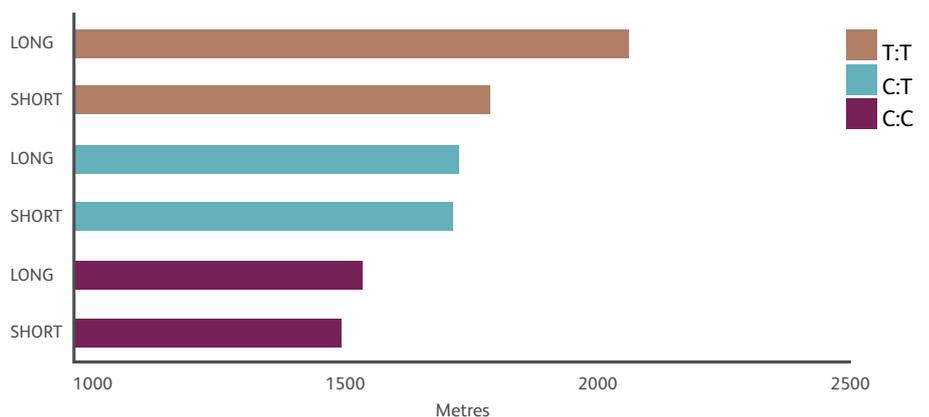
Distance Plus Score

	Average Best Race Distance (USA winners only – 406 horses)	Average Best Race Distance (Global winners only – 2254 horses)
C:C-short	1489m	1339m
C:C-long	1533m	1500m
C:T-short	1720m	1720m
C:T-long	1739m	1865m
T:T-short	1827m	2042m
T:T-long	2031m	2306m

“ I have seen examples within my own horses which demonstrate how the [Speed Gene] genetic test result can be a more accurate indicator of the optimum distance for an individual than pedigree alone. ”

**John Hammond,**  
**Trainer, France**  
**Group 1-winning trainer**

Average Best Race Distance  
 508 Winners (USA only)

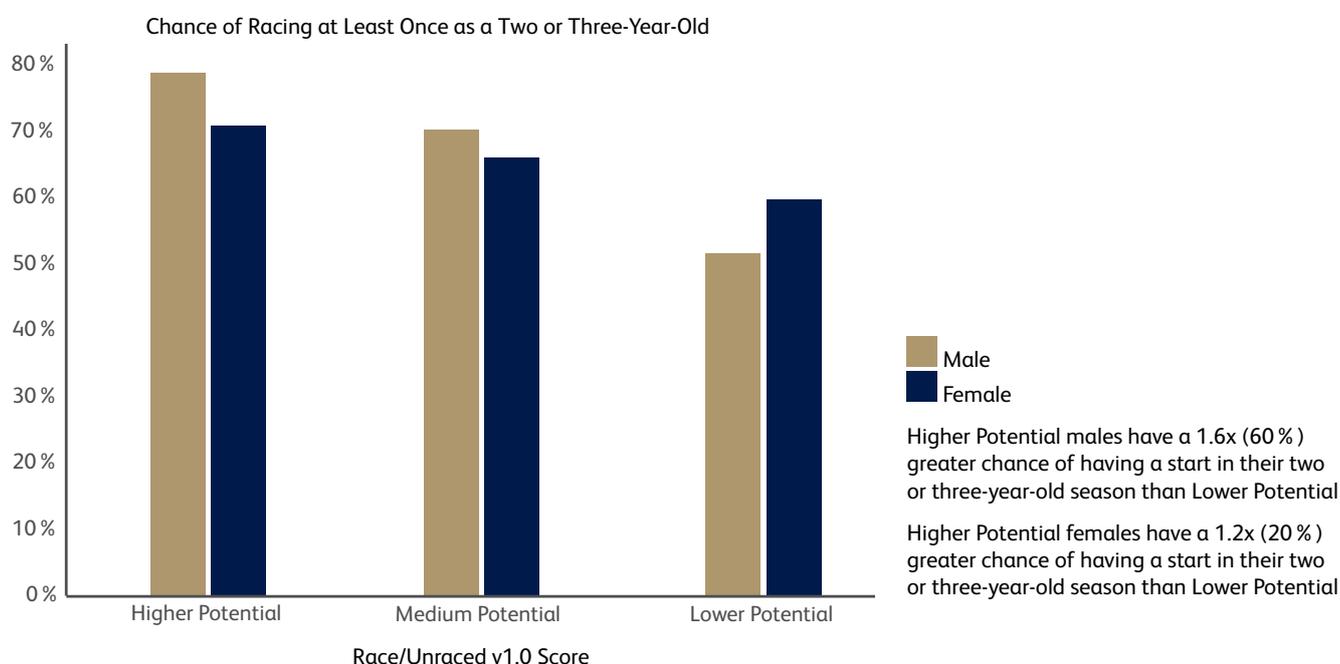


## Raced/Unraced v1.0 NEW

### Identify foals with the greatest potential to have a racetrack start as a two or three-year-old

It has been estimated that as many as 30-40% of Thoroughbred foals never make it to the racetrack. Raced/Unraced v1.0 identifies those horses with the greatest potential to have a racetrack start in their two-year-old or three-year-old season. It is understood that there are multiple reasons as to why an individual might never make it to the racetrack. We have also identified genetic contributions that may underpin these traits.

The test was developed using over 4,000 horses from all major race regions and over 48,000 genetic markers. Horses are ranked as Higher Potential, Medium Potential or Lower Potential for a racetrack start.



## Case Study - North America

268 horses from two leading US stud farms

- Horses with a Lower Potential score were 61% more likely to not have had a start as a two or three-year-old than horses with a Higher Potential score
- 89% of the horses with a Higher Potential score started as a two or three-year old
- 78% of the horses with a Lower Potential score started as a two or three-year old
- Note these were all breeding stock and therefore a higher average than the general population would have raced

Raced/Unraced v1.0 score	% of Population	% Raced (as 2 or 3-year-old)	% Unraced (as 2 or 3-year-old)
Higher Potential	26%	89%	11%
Medium Potential	33%	84%	16%
Lower Potential	40%	78%	22%

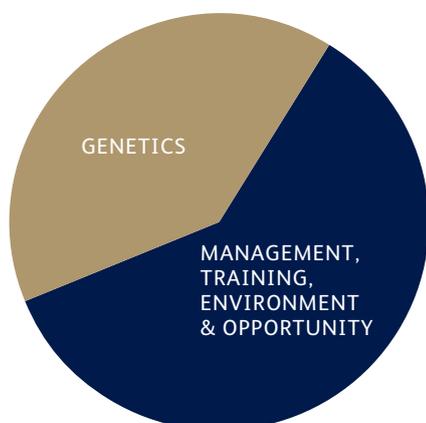
## Elite Performance Test v3.0

**NEW**

**Achieve higher strike rates by identifying the highest genetic potential for elite breeding and racetrack success through analysis of 48,000+ markers**

The Elite Performance Test v3.0 is the most comprehensive method of predicting genetic potential for elite racing and breeding performance. Elite success depends on inheriting the optimal combination of genetic markers and being given every chance to maximise this genetic potential.

Genetics contributes up to 40% of the variation in performance ability. This test provides a greater understanding of an individual's strengths and weaknesses and could help to inform management practices to give every individual the best chance of success. The test provides three outputs, Genomic Racing Value, Genomic Breeding Value and Genomic Inbreeding Value.



**670,000**

genetic markers analyzed

**48,000+**

genetic markers used in test

**4,000+**

horses used in development

**803**

Horses used that won or placed at Graded Stakes level in all major racing regions (except Japan)

Regional differences between Europe, North America, Australasia and South Africa were accounted for in the test development.

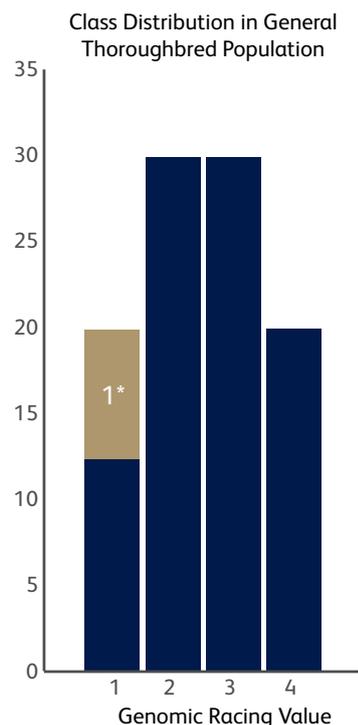
“ Woodside Park Stud were very pleased with the price for one of their yearlings that had an excellent genetic score, which achieved a premium that well exceeded their expectations in advance of the sale and said “We are glad that we had the tests done as I’m sure it helped us get that little bit extra on our colt.” ”

Murray Tillet, General Manager,  
Woodside Park Stud, Australia  
Home of Written Tycoon and Zoustar

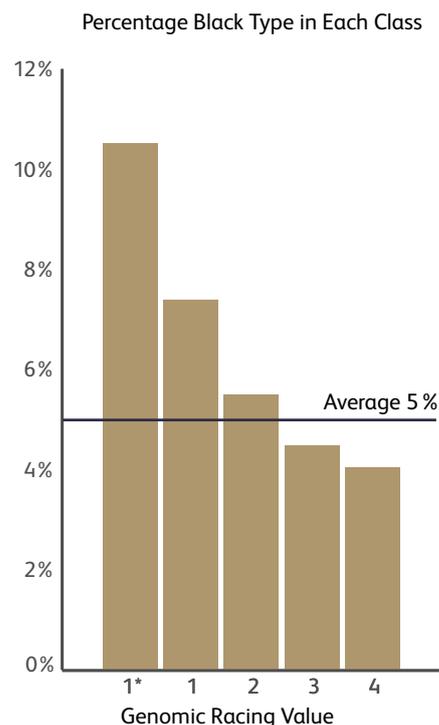
## Genomic Racing Value

A Genomic Racing Value (GRV) of 1–4 is assigned to each horse. A Class 1 horse has the greatest potential to be an elite racehorse, while a Class 4 horse has the lowest potential

A score of 1\* highlights Class 1 horses that are at the very top of the range.



Almost 40% of the Class 1 horses are Class 1\*. Class 2 and 3 are the most common classes in the general Thoroughbred population

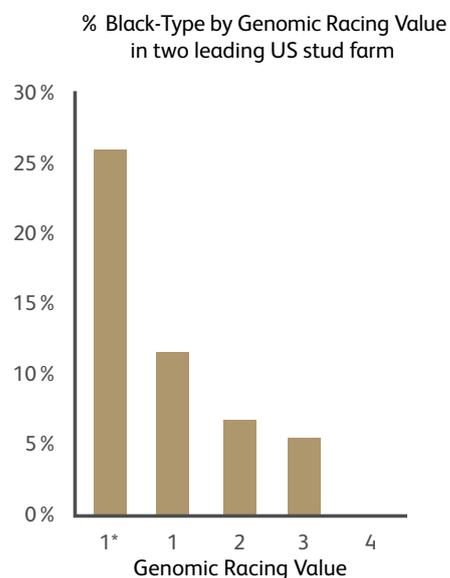
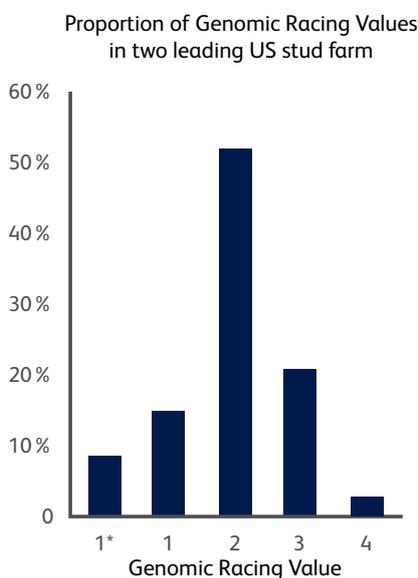


Class 1\* horses are over two times more likely to achieve black type than Class 4 horses

## Case Study - North America

273 horses from two leading US stud farms

- Class 1\* horses had a 3.7 times better chance of being black-type than Class 3
- Class 1 horses had a 71% better chance of being black-type than Class 3
- Low proportion of Class 4 horses as fewer retained due to poorer average race performance, and none of the Class 4 were black-type winners
- High proportions of black-type horses in elite broodmare band



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## Genomic Breeding Value

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**The Genomic Breeding Value (GBV) represents the potential for a broodmare or stallion to produce offspring with a higher potential for elite success. This is based on an assessment of the favorable genetic variants that can be passed on to the foal**

Each horse is given a Genomic Breeding Value (GBV) of 1–4, where a value of 1 indicates the highest probability of producing elite racehorses.

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## Genomic Inbreeding Value

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**The Genomic Inbreeding Value evaluates the actual level of inbreeding in a Thoroughbred horse, which can be used to inform future mating decisions**

Each horse is given a value of Low, Medium or High for Genomic Inbreeding.

- A high value means that the individual has inherited a significantly greater proportion of identical genetic information from sire and dam.
- Our research indicates that individuals with a lower level of genomic inbreeding have a slightly higher probability of being elite racehorses.

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## Case Study

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Pedigree is generally a good indicator of expected level of inbreeding, but it can also be misleading (see table). Level of Genomic Inbreeding can have important consequences for future breeding decisions.

The table shows the actual Genomic Inbreeding of a horse versus the apparent level of duplication illustrated by the pedigree. **Stallion C** appears to have a high level of inbreeding based on pedigree, but

genetically has a low proportion of identical genetic markers. **Stallion F** appears to have a low level of inbreeding based on pedigree, but genetically has a very high proportion of identical genetic markers and is relatively highly inbred.

Stallion	Genomic Inbreeding Value	Duplicates in 5 Generation Pedigree
A	Low	4
B	Low	2
C	Low	8
D	Low	2
E	High	6
F	High	0

## Dirt vs. Turf v1.0 NEW

### Identify prospects suited to dirt or turf racing

Surface preference is considered to be indicated by pedigree and physical type since sires are often ranked according to the success of their progeny on different surfaces. However, it is often unclear until a horse has raced a number of times as to which surface it is best suited to. Similarly, some stallions can produce progeny with different surface preferences, in which case pedigree does not always indicate surface

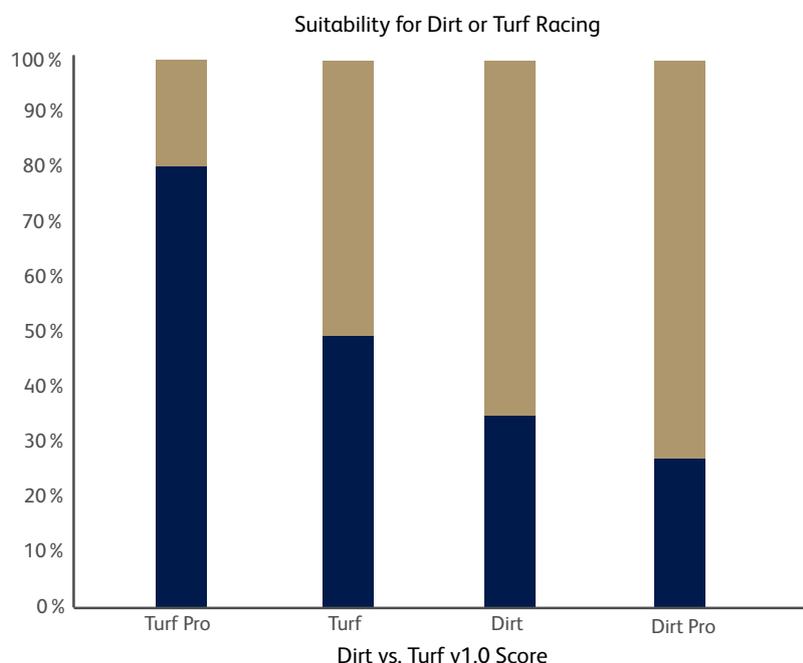
preference type. Dirt vs. Turf v1.0 indicates genetic affinity of an individual for achieving their best win on dirt or turf surface.

In the USA, 68 % of Graded Stakes races are run on dirt and 32 % are run on turf, while in Europe, the majority (98 %) of Graded Stakes races are run on turf. This test, developed using horses raced in North America, analyzes over 48,000 genetic markers to determine the result.

Dirt  
 Turf

Horses are categorised as:

- Turf Pro – 80 % suited to turf racing
- Turf – 50 % suited to turf racing
- Dirt – 64 % suited to dirt racing
- Dirt Pro – 75 % suited to dirt racing



### Case Study - North America

273 retired racehorses from two leading US stud farms

- Horses with a 'Dirt Pro' result were 6.7x more likely to have won/placed on only dirt than turf
- Horses with a 'Turf Pro' result were 2.0x more likely to have won/placed on only turf than dirt
- The smaller amount of turf races available probably means that more turf horses raced on dirt due to lack of opportunity

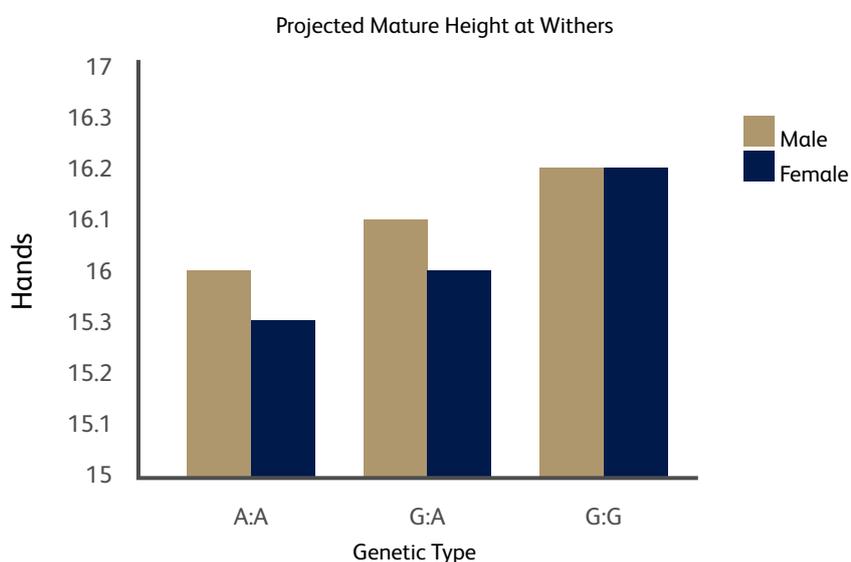
Dirt vs. Turf Score	% of Population	Dirt Win/Place Only	Turf Win/Place Only
Dirt Pro	29 %	87 %	13 %
Dirt	17 %	79 %	21 %
Turf	25 %	50 %	50 %
Turf Pro	30 %	33 %	67 %

## Projected Height Test

**Predict with confidence the expected mature height of a young foal; breed more horses of the desired height**

Mature height at withers can be predicted from birth within 2.54cm (1 inch), with a 70% success rate, based on DNA analysis of the *LCORL/NCAPG* gene region and the sex of the horse.

At the *LCORL/NCAPG* gene region, a position in the DNA code contains either the genetic marker G or A. Each individual has two copies of the gene – one inherited from each parent, so there are three possible combinations of genetic markers: A:A, G:A, G:G.



Genetic Type	Physical Type	Precocity	Breeding Potential
A:A	Small	Female 161.08cm (approx. 15.3hh) Male 162.80cm (approx. 16hh)	Can only produce small or medium horses
G:A	Medium	Female 163.44cm (approx. 16hh) Male 165.14cm (approx. 16.1hh)	Can produce small, medium or tall horses
G:G	Tall	Female 168.28cm (approx. 16.2hh) Males 168.28cm (approx. 16.2hh)	Can only produce medium or tall horses

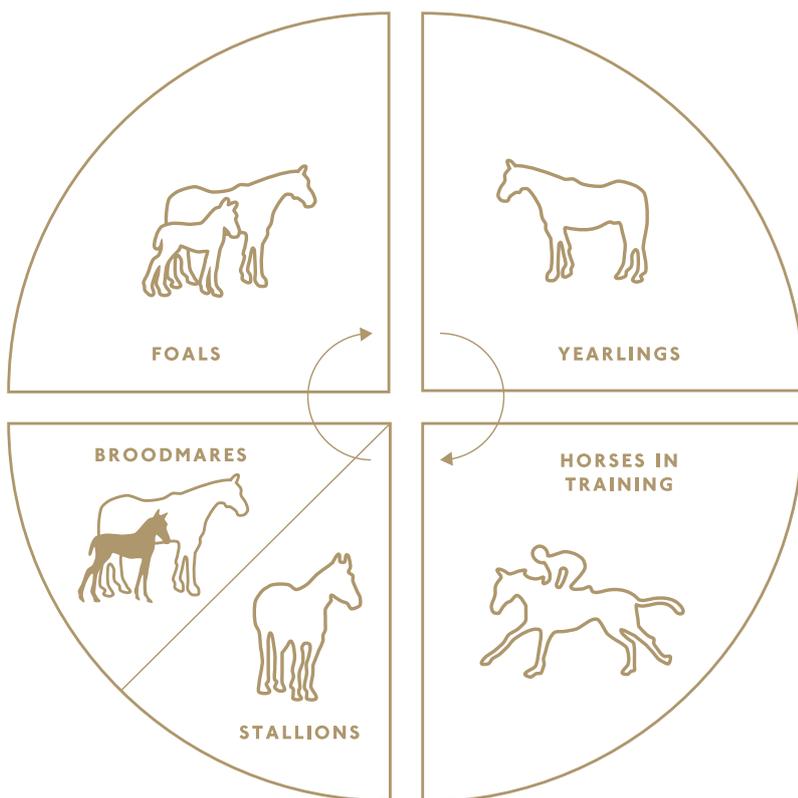
“ I find the genetic information provided by Equinome highly credible and it's interesting to see how this information can be applied in both Breeding and Racing. As a breeder, it is helpful to be able to use genetic information along with other selection criteria to make those tough decisions. ”

Marguerite Joyce,  
Cahermorris Stud, Ireland  
Breeder of Group 3 winner Smash Williams

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## Applications

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### FOALS & YEARLINGS

- Inform selection and sales decisions
- Identify most precocious prospects

### HORSES IN TRAINING

- Reduce operating costs
- Optimize training regime
- Fine-tune racing strategy

### STALLIONS

- Predict stamina index for young stallions
- Promote stallion potential
- Inform selection and sales decisions

### BROODMARES

- Optimize breeding outcomes
- Identify optimal breeding stock
- Select compatible stallions
- Inform selection and sales decisions

“ All of our mares have been tested under the Speed Gene Test, and we see it as a useful application of scientific knowledge to the alchemy of breeding a champion. Breeding is still an art form, no matter how much information science can give you, but you try to take as much guesswork out of it as you can. ”

**Rick Barnes, Owner and Breeder,  
Grangecon Stud, Ireland  
Group 1-winning breeder**

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## Plusvital Supplements

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**Premium supplements  
balanced with the latest  
scientific thinking and  
anti-doping expertise**

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### Racing Syrup

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Palatable molasses-based multivitamin, amino acid and trace element balancer supplement. Scientifically formulated to take the guesswork out of balancing the daily feed ration of the racehorse

#### Key Features

- 30 vitamins, minerals, trace elements and amino acids
- Meets and exceeds NRC recommendations
- Increased vitamin E to reduce oxidative stress
- Selenium to neutralise free radicals and support the immune system
- Branched chain amino acids and threonine to support muscle recovery
- Zinc and biotin to support growth of healthy hoof and hair.

Available in 2 or 5 litres. Daily dose 60ml, no further supplementation is required. Please consult with an equine nutritionist or veterinary surgeon before using in conjunction with other supplements.



multivitamins



branched chain  
amino acids



molasses  
based

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### Breeding Syrup

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Source of vitamins, minerals and amino acids to help support the breeding horse and foal

#### Key Features

- Highly palatable molasses-based balancer
- Supports the needs of the mare and stallion during the breeding season
- Complete multivitamin, amino acid and mineral formation
- Contains folic acid, essential for cell formation and for DNA metabolism
- Essential amino acids lysine and methionine – crucial for growth and bone development
- B vitamins have been added for their role in cell reproduction and growth

Available in 5 litres. Daily dose: Broodmares 60ml daily, foals and yearlings 30ml daily, stallions in service 90ml daily, stallions for maintenance 60ml daily.



enhanced  
flavour



easy to pour



molasses  
based

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### Other Products

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#### Neutragast



Comprehensive gut support for horses  
prone to gastric disturbances

#### E-Dash



Innovative anti-oxidant support  
for the performance horse

#### Recovery-7



Highly concentrated formula to  
aid in muscle recovery after  
peak performance

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“ The global movement of horses and the vagaries of regional racing programmes mean that sometimes a pedigree doesn't always give the truest picture of a horse's natural aptitude regarding its best distance and precocity. I have found the Speed Gene Test an extremely useful tool in levelling those differences and giving some concrete data that can help provide a more tailor-made training programme for each horse. This helps give the horse and owner their best possible chance for success. ”

**Francis-Henri Graffard,**  
Group 1-winning trainer

“ Isla Bonita, winner of Japanese 2000 Guineas (G1) in 2014 was genotyped as a two-year-old and confirmed by the owner to be C:T. This is why he had confidence in stepping him up to a mile and a half for the Japan Derby (G1) where he placed second, three-quarters of a length behind the winner. Isla Bonita then won his next race, the St. Lite Kinen (G2) over 1500m. ”

**Hironori Kurita,**  
Trainer, Isla Bonita

“ After finding out that she was a T:T, she was tried at 2200m and won first time out. She has subsequently won a Stakes race at 2400m and Grade 2 at 3200m. Her value as a broodmare has now obviously increased greatly as a result of the change in race distance and addition of black type, as well as the additional prize money returned. ”

**Tinus Gericke,**  
Leading South African owner/breeder



**Commitment to Science**

Our research team consists of world-leading experts in molecular biology, genomics, bioinformatics, computational biology, equine exercise physiology and nutrition

**200+**

scientific  
papers

published by members  
of our research team

**13,000+**

horses  
genetically  
tested

**9**

book  
chapters

authored by  
members of our  
research team

All our nutritional products are manufactured to EU feed hygiene standards and are designed in accordance with the FEI and Jockey Club regulations

“ When it comes to published academic research, Hill may be champion among the geneticists engaged in the search for the secrets of equine athletic potential. ”

Scientific American

**1,000+**

Black Type winners tested worldwide

clients in  
**28**  
countries worldwide

including all major racing jurisdictions

## How to Order

If you would like to arrange for genetic testing of your horses, please contact us directly for a quote and instructions for the collection and shipping of samples to Plusvital laboratories. Plusvital is able to accept DNA samples from all major bloodstock regions of the world. The process is simple and involves a 4–5ml uncoagulated blood sample from each horse in a purple cap K2-EDTA tube.

Plusvital Genetics (North America)  
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