

Frequently Asked Questions: Jersey Haplotype 1 and Jersey Haplotype 2

December 2014

What is Jersey Haplotype 1?

Designated in June of 2011, Jersey Haplotype 1 (JH1) was initially mapped as a 73-marker haplotype on *Bos taurus* autosome 15 (technical label BTA15) based on fertility records of 830,391 Jersey females. AIPL geneticists found that JH1 was associated with average reduction in conception rate of 3.7%. Embryonic losses occur very early in gestation (less than 60 days).

Subsequent study of the haplotype narrowed its size to one (1) marker (SNP), and the biological cause of embryo loss was identified as a loss-of-function (LOF) mutation in one gene, *CWC15*. The mutation stops the gene from producing a protein required for cellular development, resulting in embryo loss. Since January, 2013, an exact test for the LOF mutation has been included in genotype chips offered by the AJCA.

What is the carrier frequency of JH1 in the Jersey population?

JH1 has been present in the Jersey population for 40-plus years. Current frequency is 24%. This means that 76% of the population does not have the JH1 haplotype.

What is Jersey Haplotype 2?

Designated in June of 2014, Jersey Haplotype 2 (JH2) was discovered on *Bos taurus* autosome 26 (BTA26) using data from the Council on Dairy Cattle Breeding (CDCB). The estimated effect on conception rate is $-4.0\% \pm 1.5\%$ based on study of carrier sire by carrier maternal grandsire matings. Embryos are lost by 60 days after insemination.

What is the carrier frequency of JH2 in the population?

JH2 frequency was 14% to 28% prior to 1990. It has decreased steadily to 2.6% currently.

Why did the Board of Directors designate Jersey Haplotypes 1 and 2 as undesirable genetic factors?

Reproductive efficiency is an important Jersey breed characteristic, and a key to the profitability of your Jersey business. By designating JH1 and JH2 as undesirable genetic factors, information will be available to all Jersey owners so that they can limit carrier-to-carrier matings and manage the impact of the haplotypes on embryo loss.

What is the basis for designating JH1 and JH2 status?

JH1 status was determined by identification of the haplotype from a 6K or higher genotype until January of 2013, when a direct test for the *CWC15* gene mutation was included on genomic test chips.

JH2 status is based on identification of the JH2 haplotype from a 6K or higher-density genotype.

How will this information be published?

Status of an animal is listed as F designating status Free, C designating status Carrier. When an animal is tested as a carrier, the recorded owner, the breeder, any lessee, and any third-party nominator will receive the results from the AJCA. The association maintains a record of all animals that have been designated carriers, and such designation shall be noted on all advertising, descriptive materials, or pedigrees published by the AJCA. This includes Genomic Evaluation Reports, Official Performance Pedigrees, Performance-Progeny Reports and genetic evaluation reports.

Animals that have a 3K genotype do not have JH1 or JH2 status reported on their performance pedigree. Why?

The 3K genotype was not sufficiently accurate in identifying haplotype status. The 3K chip was phased out in late 2011.

What can I expect if I mate a carrier of JH1 to a carrier of JH1, or a carrier of JH2 to a carrier of JH2?

As shown below, there is a 25% chance that the embryo would inherit two copies of JH1 and not survive.

The chance that the calf would be a carrier is 50%. But there's also a 25% probability that the mating would result in a calf that does not inherit the haplotype from either parent.

NOTE: To show probabilities for JH2, replace JH1 in the table with JH2.

OUTCOMES FROM MATING CARRIERS OF JH1

JH1C FEMALE	Normal (N)	JH1
JH1C MALE		
Normal (N)	N - N <i>Normal Non-carrier</i>	N - JH1 <i>Heterozygous Carrier</i>
JH1	JH1 - N <i>Heterozygous Carrier</i>	JH1 - JH1 <i>No calf born</i>

What about matings of a carrier bull to non-carrier females? In both instances, half of the offspring (50%) will be carriers of the haplotype.

OUTCOMES FROM MATING JH1 CARRIER TO NON-CARRIER

FEMALE	Normal (N)	Normal (N)
JH2C MALE		
Normal (N)	N - N <i>Normal Non-carrier</i>	N - N <i>Normal Non-carrier</i>
JH2	JH2 - N <i>Heterozygous Carrier</i>	JH2 - N <i>Heterozygous Carrier</i>

How will JerseyMate handle JH1 and JH2?

JerseyMate *eliminates* matings of designated JH1 carrier bulls to designated JH1 carrier females. JerseyMate *discounts* potential matings including one JH1 carrier for the cost of days open based on the probability of inheriting JH1. The economic impact of a lost embryo due to JH1 is estimated at \$84 (42 days open x \$2.00/day).

However, JerseyMate has not been updated to eliminate JH2 carrier-to-carrier matings, or discount matings to a JH2 carrier.

Jersey Haplotypes 1 and 2

Description of Conditions and Determination Procedures

With background from Policies Regarding Undesirable Genetic Factors, effective June 24, 2014

Statement of Policy

Every effort should be made within the breed to identify those animals that carry undesirable genetic factors. The American Jersey Cattle Association considers it the responsibility and obligation of each member of the Association and each breeder of Jersey cattle to report to the Executive Secretary any known case of an abnormal Jersey animal. The Executive Secretary shall maintain records of abnormalities and shall make available information from such records in accordance with rules established by the Board of Directors from time to time.

The Board of Directors considers it to be unethical practice to offer for sale an animal, male or female, an embryo or semen from an animal that has been designated a carrier of an undesirable genetic factor without first informing the prospective buyer of this fact. In practice this means that any advertising, descriptive material, or pedigree containing a designated carrier of an undesirable genetic factor shall carry a statement indicating designated carriers.

This statement of policy is made in belief that it is in the best interests of the breed and the breeders of Jersey cattle. It is made in the belief that it will serve the position of those who have taken the more difficult, positive, open approach to this fundamental concept of ethics in the improved breeding of dairy cattle. In the long run, all serve to gain by such a policy, but only to the degree that all cooperate in the acceptance and enforcement of this policy.

Identification of Undesirable Genetic Factors

In determining what genetic factors are considered to be undesirable in the Jersey breed, the Board of Directors shall consider such evidence as it considers appropriate. The Executive Secretary shall make such investigations of genetic factors occurring in Jersey animals as he or she may believe necessary or advisable and shall report the results of his or her investigations to the Board of Directors. Before recommending that the Board make a determination regarding the existence of an undesirable genetic factor, the Executive Secretary shall consult with at least two experts whose recommendations shall be submitted to the Board.

Identification of Carrier Animals

When the Board of Directors shall determine that an undesirable genetic factor exists in the Jersey breed, the Board shall take whatever action it may consider appropriate to control and limit the genetic factor. Such action will include procedures to identify animals that are probable carriers of the undesirable genetic factor and to inform persons having an interest in the Jersey breed of the identity

of such probable carriers. The procedures for publication of the identity of probable carrier animals, referred to as "designated" carriers, are contained in supplemental statements adopted with respect to each undesirable genetic condition.

For each undesirable genetic condition the Board of Directors shall adopt a separate statement of procedures for designating animals, referred to as "Statement of Designation Procedures," and designate an official report form to be used for reporting affected animals. The Board of Directors shall be responsible for designating animals as carriers of an undesirable genetic factor. When an animal has been designated as a carrier, the Executive Secretary shall notify the last recorded owner, the breeder, any lessee, and any third-party nomination by regular U.S. Mail.

The Board of Directors may adopt procedures and rules by which a Jersey may be progeny tested for a particular undesirable genetic factor. The rules and procedures for progeny testing are contained in supplemental statements adopted with respect to each undesirable genetic condition.

The policy of the Association is to identify and designate Jersey animals as carriers of undesirable genetic factors when (1) genomic detection based on DNA analyses and/or (2) documentation of their own progeny is sufficient to accomplish designation.

Publication and Release of Information

Male and Female Animals

The Executive Secretary shall maintain a record of all animals that have been designated carriers of an undesirable genetic factor, and designation shall be noted on all advertising, descriptive material, or pedigrees published by the Association containing reference to a designated carrier. The Association shall also notify the recorded owner, the breeder, any lessee, and any third-party nominator if the animal carries an undesirable genetic factor.

Except as provided in this statement of policies, no information concerning the genetic condition of any animal shall be released by the Association without approval of the Board of Directors. *(text continues)*

Jersey Haplotype 1 (JH1) Statement of Designation Procedures *Designated June 2011* *Revised November 2011, August 2013*

Description of Condition

Jersey Haplotype 1 (JH1) designates a reduction in fertility, specifically early embryonic loss, attributable to a specific haplotype on *Bos taurus* autosome 15 (BTA15). Subsequent investigation identified the biological cause of

embryo loss as a loss-of-function mutation in the *CWC15* spliceosome-associated protein homolog gene (Sonstegard et al., 2012, *PLoS ONE*, 8:354872).

Determination of JH1 Status

The Board of Directors will not designate an animal either a carrier or free of JH1 haplotype if the Board considers that there is a reasonable doubt that the animal is a carrier. The determination as to reasonable doubt depends upon the quality and amount of available evidence which will vary in each case.

Official JH1 status is obtained (1) by direct observation of the loss-of-function (LOF) mutation in *CWC15* in the genotype of an animal, or (2) by use of LOF mutation test results of family members to determine if the mutation is contained in the JH1 haplotype of other genotyped animals, and reassessed as additional information is obtained from DNA analyses.

With respect to all sales sponsored by the Association, a bull shall not be accepted unless designated free of Jersey Haplotype 1.

Jersey Haplotype 1 (JH2) Statement of Designation Procedures *Designated June 2014*

Description of Condition

Jersey Haplotype 1 (JH2) designates a reduction in fertility, specifically early embryonic loss, attributable to a specific haplotype on *Bos taurus* autosome 26 (BTA26). Jersey Haplotype 2 (JH2) is associated with decreased conception rate. It is not associated with still births. When JH2 is inherited from both sire and dam, either conception does not occur or a spontaneous abortion results; however, the exact physiological, morphological or biological condition is not fully understood nor has a candidate gene search identified any known causative mutations.

Determination of JH2 Status

The Board of Directors will not designate an animal either a carrier or free of JH2 haplotype if the Board considers that there is a reasonable doubt that the animal is a carrier. The determination as to reasonable doubt depends upon the quality and amount of available evidence which will vary in each case.

The Board will designate a carrier animal based on the identification of the JH2 haplotype from a 6K or higher-density genotype. All genotyped males and females will carry genetic codes as associated with Jersey Haplotype 2 as follows: Carrier of JH2 as JH2C; Tested free of JH2 as JH2F.

With respect to all sales sponsored by the Association, a bull shall not be accepted unless designated free of Jersey Haplotype 2.