Evaluating Potential Markers for Selection for Disease Resistance: the Health Traits Project

A.S. Leaflet R1900

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Introduction

As mentioned in the preceding report, marker assisted selection for disease resistance is possible only if the marker is associated with disease incidence. With this in mind, a study was initiated here at Iowa State University to evaluate potential markers for disease resistance and to look for associations between these markers and disease incidence in dairy cattle. This study, known as the Health Traits Project, is being done in cooperation with Genex/CRI (Al Kuck and Steve Schnell), producers participating in Genex's progeny test program, the National Animal Disease Center (Marcus Kehrli, Jr.), and the University of Wisconsin-Madison (George Shook).

Materials and Methods

During the first part of the Health Traits Project (Steve Kelm's Ph.D. dissertation research), dexamethasone was given to 54 Holstein bulls owned by Genex that were awaiting progeny test. Dexamethasone (a synthetic cortisol) causes a significant, but temporary, decline in immune response (immunosuppression). Bulls were treated with dexamethasone so that their immune systems could imitate the immunosuppression that occurs around calving in dairy cows. Because the immune system is suppressed around calving time, dairy cows tend to have more disease at this time.

Blood samples were taken from the 54 bulls the week before, during, and after dexamethasone treatment. These blood samples were used to conduct 15 tests of each bull's immune response. Most of the tests measured the ability of neutrophils (a type of white blood cell) to move to an infected area and kill disease-causing organisms such as bacteria. From these tests, it was determined that some bulls had better immune response than others. Part of the variation in the 54 bulls' immune response was due to genetic differences. The heritability of the traits measured by the 15 tests averaged 0.35, indicating that 35% of the variation in these traits was due to genetics.

These results indicate that AI bulls could be selected for disease resistance based on variation in their immune response. However, genetic improvement of disease resistance is possible only if variation in bulls' immune response is related to variation in daughters' disease incidence. So, for the second part of the Health Traits Project, producers are recording disease incidence (including reproductive and metabolic disorders) on the progeny test daughters of the 54 bulls and their herdmates. Producers will also record treatments (includes preventative measures such as vaccinations). Health data (disease incidence and treatments) will be recorded from birth until the end of first lactation or when the animal leaves the herd, whichever comes first. These data will be compared with the bulls' immune response data to see whether variation in bulls' immune response is related to variation in daughters disease incidence.

A total of 286 herds has recorded health data for calves and heifers; 157 herds have recorded health data for first lactation cows. Table 1 presents the total number of progeny test daughters and herdmates.

Table 1. Total number of progeny test daughters and herdmates.

	Calves & heifers	1st lactation cows
Progeny test dtrs.	2,933	1,299
Herdmates	81,653	86,693
Totals	84,586	87,992

Results and discussion

Table 2 presents the most common diseases recorded in calves and heifers and first lactation cows as a percentage of all records of disease incidence for the age group being considered. Together, scours and pneumonia accounted for 72% of the disease incidence in calves and heifers. Mastitis and reproductive disorders (follicular cyst, retained placenta, and uterine infection) accounted for 59% of the disease incidence in first lactation cows.

Table 2. Most common diseases recorded in progeny test herds.

Diseases	Calves & heifers (%)	1st lactation cows (%)
Coccidiosis	3	
Corn, abscess, cyst		5
Displaced abomasum		6
Follicular cyst		4
Ketosis		5
Mastitis		44
Off feed	5	3
Pneumonia	28	5
Retained placenta		6
Scours	44	
Uterine infection		5
Other	20	17

While producers are recording disease incidence, milk yield and somatic cell count (SCC) data for progeny test daughters and their herdmates are being received from DHIA. The yield data will be used to adjust comparisons of immune response and disease incidence for the amount of milk produced. Yield data may also be compared with the disease incidence data to see whether variation in cows' disease incidence is related to variation in their milk production. The results may provide further verification of the reduction in disease resistance resulting from selection for yield. The SCC data will be compared with the disease incidence data to see whether variation in cows' SCC is related to variation in their disease incidence. The SCC data will also be compared with the bulls' immune response data to see whether variation in daughters' SCC is related to variation in their sires' immune response. The results may provide a biological explanation of why daughters of sires that transmit lower SCC have lower mastitis incidence.

Blood samples are also being collected from the progeny test daughters. These blood samples will be used to determine which copies of the Bovine Lymphocyte Antigens (BoLA) genes daughters received from their sires. These data will be compared with the disease incidence data to see whether daughters receiving different copies of the BoLA genes differ in their ability to resist disease. The BoLA genes are partially responsible for the development and function of the cow's immune system (environment as well as other genes also impact the immune system). Animals with different copies of the BoLA genes are known to vary in their resistance to some diseases.

If the Health Traits Project finds that variation in immune response or the BoLA genes are related to variation in disease incidence, then these markers may be used to select for disease resistance. Because these markers can be measured on bulls, dairy producers can take advantage of them without recording disease incidence in their herds.