ANNUAL RESEARCH PROGRESS REPORT
Report of Progress (AD-421)

Accession: 0147983 Year: 98 Project Number: 1265-31000-056-00 D
Mode Code: 1265-05-00 STP Codes: 3.1.2.1 20% 3.1.2.2 80%
NATL PROG(S) 101 Animal Genomes, Germplasm, Reproduction & Development 100%

Title: IDENTIFY AND EVALUATE GENETIC FACTORS TO IMPROVE EFFICIENCY OF MILK YIELD

Period Covered From: 01/98 To: 08/98

Progress and Outcomes:

1. What major problem or issue is being resolved and how are you resolving it?

The Animal Improvement Programs Laboratory (AIPL) is responsible for compiling a quality data base of pedigree and lactation information on dairy cattle to be used for in-house and cooperative research, including calculation of USDA-Dairy Herd Improvement Association (DHIA) genetic evaluations for yield. A national database of high accuracy is being maintained and expanded for genetic research on milk and component yield of dairy animals and is being made accessible to domestic and international users.
Dairy Herd Improvement data have been one of the most valuable dairy research files in the world because of the national uniformity in field and computing procedures. Economic considerations have led to a number of new testing strategies, particularly in regard to frequency of acquiring milk weights and taking milk samples. Reliability of data from less supervised plans needs to be optimized as well as more extensive use made of electronically captured data from automated equipment. Traditional and recently initiated lower cost test programs are being compared by AIPL to determine accuracy of information and to identify variables contributing to that accuracy. Procedures were developed to utilize test-day data, new testing variables, and correlated traits to provide more information.
Steady increases in milk and component yield in the United States are attributed to rapid genetic improvement and more effective management practices, but interrelationships among any number of environmental sources of variation and yield are changing continually. Changes in environmental factors from new biotechnology also are forcing changes in genetic evaluation techniques. Ways to improve genetic evaluations for yield traits of dairy animals and to provide them to the industry are

being investigated by AIPL. Environmental factors (such as age, parity, season, and days open) and nonadditive genetic factors (such as inbreeding and heterosis) are being studied and for possible incorporation to improve accuracy of evaluations.

The world's dairy producers have become more closely united through breeding programs of international scope. In many countries, producers obtain semen from foreign sources, and research results are needed to support decision making on which bulls are best. Work by the International Bull Evaluation Service (Interbull) in Sweden has been supported by AIPL through the cooperative development of international evaluations for yield

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traits of economic interest. In addition, AIPL has developed conversion procedures for yield evaluations across countries when needed and is incorporating foreign data into USDA evaluations so that producers can have comparable information on genetic merit from all sources. support decision making on which bulls are best.
The individual genes that influence important traits of animals are becoming much easier to identify and to use in selection programs. Numbers of quantitative trait loci (QTL's) and the size of their effects have yet to be determined. To identify QTL's, AIPL is investigating the association between yield traits and genetic markers; methodology to utilize such information in genetic evaluations is being developed.

2. How serious is the problem? Why does it matter?

Over the 5-year life of this CRIS project, financial benefits as a result of continuing genetic improvement were estimated to be $158 million for improved production efficiency of 9.8 million dairy cattle, $55 million for semen sales, $2 million for export of embryos, and $10 million for export of animals.
Because of deficiencies in identification, 35% of all official lactation records available through dairy records processing centers (DRPC's) are rejected by AIPL. Usable identification approaches 100% in some countries, and significant increases should be attainable in the United States.
Several industry groups, including the National Association of Animal Breeders (NAAB), National DHIA, and members of the Purebred Dairy Cattle Association, had encouraged USDA to re-examine adjustment factors to determine if methods are appropriate or if biology has changed over time.
Accurate adjustment to standardize production records is necessary to eliminate bias that could otherwise enter into genetic evaluations.

3. How does it relate to the National Program(s) and National Program Component(s) to which it has been assigned?

National Program 101, Animal Germplasm, Resources, Conservation and Development (100%). This research allows more accurate and rapid identification

and characterization of dairy animals with potentially useful germplasm for improved yield efficiency. Genomic maps and their associated DNA markers are being developed to improve the accuracy of selection for yield traits, increase the frequency of desirable genes in populations, and characterize valuable germplasm populations. Development of a DNA bank (including storage and distribution facilities) and a database to supplement the Dairy Bull DNA Repository was initiated in cooperation with the Gene Evaluation and Mapping Laboratory (GEML).

4. What was your most significant accomplishment this past year?

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At the request of the dairy industry, new genetic indexes were developed to predict the net economic merit of dairy cows that produce for fluid milk and cheese markets. Incomes and costs from feed, longevity, and mastitis resistance were combined with prices used in fluid and cheese markets. A similar index for protein markets had been developed previously. After implementation of the new merit indexes in February 1999, dairy producers will be able to base their breeding decisions on indexes that incorporate the net price formulas that are closest to the price expected in about 5 years when offspring resulting from current matings would be lactating. Suppliers of seed stock also will be able to select for long-term national or global demands instead of short-term local prices.

5. Describe your major accomplishments over the life of the project, including their predicted or actual impact

High and unstable estimates of Holstein genetic trend for milk yield based on USDA-DHIA evaluations indicated a failure by the animal model evaluation system to maintain consistent genetic trend over time and prompted concern about the suitability of the current statistical model for national evaluations and the influence on evaluations of factors to adjust for cow age at calving. The animal model was changed to include an age-parity effect, and the trend for all lactations became essentially the same as for first lactation. New adjustment factors that differ for cows of the same age but in different parities also were implemented for calving age and season. These new factors and the improved statistical model resulted in more accurate evaluations, thus increasing the ability of dairy breeders to improve their cattle genetically for yield efficiency.
To allow implementation of a test-day model that will provide more accurate genetic evaluations, test-day data were collected from various sources, matched with existing lactation data, and stored in a database. Cooperators were contacted for additional data if test-day data were missing. Variance components, heritabilities, and correlations among lactation stages were estimated for milk, fat, and protein yields to

support further steps in implementing a test-day model for the U.S. dairy industry.

Interbull has combined national bull evaluations into international evaluations since August 1994, but the benefit of using data from multiple countries was still in question. To determine if including multinational data through the Interbull evaluation process improved prediction of future national evaluations, national and international Holstein bull evaluations from Canada, France, Germany, Italy, The Netherlands, and the United States were compared for milk, fat, and protein yields. The results indicated that including multinational data improved prediction of future

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national evaluations and suggested that usage restrictions for Interbull evaluations can be relaxed or eliminated. Recent importation of European semen into North America will increase the importance of data from other countries in improving the accuracy of U.S. genetic evaluations.
Through testing and culling since 1991 for bovine leukocyte adhesion deficiency (BLAD), a genetic autoimmune disease, no bulls sampled for artificial insemination (AI) programs now are BLAD carriers. However, the elimination of the BLAD gene might have had other undesirable effects or might have limited the rate of genetic progress for yield traits as a result of an association with those traits. Analysis of whether the BLAD gene affected milk, fat, and protein yields and component percentages or was linked to genes for those traits showed only a minimal, negative relationship for some traits. Dairy breeders should feel confident that elimination of the BLAD gene will not impede the rate of genetic improvement for these performance traits.
Milk recording in the United States is less uniform than in the past with several familiar plans and many more innovative plans with varying test intervals, incomplete data on test day, reduced supervision, and electronic recording. Widely varying plans can provide useful data for genetic evaluations, but data should be weighted according to accuracy and combined using improved formulas that adapt to data design. A best prediction statistical method was developed to compute and to plot lactation yields and provides a flexible theory to calculate 305-day yields and accuracies of those yields as measured under many different test plans. Lactation weights that reflect the accuracy of any particular record were derived. Expansion factors and weights developed for records in progress improved properties of owner-sampler records. For the first time in February 1997, records from DHI test plans coded 40 through 77, which include owner-sampler test plans, were used in USDA-DHIA genetic evaluations. Although owner-sampler records were weighted less heavily than records from supervised test plans, the additional information is expected to improve the accuracy of genetic evaluations.
More frequent evaluations had been proposed and discussed by U.S. industry groups since 1990. Shorter generation intervals and faster genetic progress can result from more frequent evaluations. In May 1997, AIPL began

quarterly (February, May, August, November) release of USDA-DHIA genetic evaluations for yield traits (milk, fat, and protein), somatic cell score, productive life, and associated economic indexes. More frequent evaluations should result in less change between consecutive evaluations, earlier release of genetic information for new bulls, and more timely indications of changes for marketed bulls. Earlier access to genetic information could increase the rate of genetic improvement in the United States by allowing earlier recognition of bulls with high merit for desired traits and earlier reassessment of previously high bulls. Changing the frequency of evaluation from two to four times per year should result

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in a 4% increase in genetic progress.
Several genes that have a potentially major effect on milk yield and components have been identified in large, important Holstein families. Research currently is focused on localizing those genes so that genetic marker information can be used to improve selection decisions. Results of this research effort benefitted all segments of the dairy industry and the public through increased yield efficiency and profitability of dairy animals. Competitiveness of U.S. dairy farms was enhanced for worldwide exports of U.S. dairy animals, embryos, and semen. All U.S. consumers of milk and dairy products have benefitted by having a more economical and higher quality food source than would otherwise be available. Increased efficiency through genetics has helped keep the farm price of milk at the same level as 20 years ago.

6. What do you expect to accomplish during the next year?

This CRIS project was terminated on August 23, 1998. A new proposal is being prepared that merges some of the general objectives of this project for yield efficiency with a recently terminated project with similar objectives for fitness-related traits. Objectives of the new project include the maintenance of a national database for genetic research on milk yield, composition, and fitness traits that is accessible for domestic and international research and industry needs; development of improved methods for comparison of genetic evaluations across countries so that producers have equitable information from all sources, especially from Interbull; investigation of the accuracy of alternative methods of genetic evaluation, especially the use of test-day observations, and comparison with the accuracy of current methods; determination of the economic values of health and reproductive traits and development of measures of overall merit that include those traits; and identification of genetic markers and determination of the feasibility of their use to improve the accuracy of evaluated traits and prediction efficiency.

7. What technologies have been transferred and to whom? When is the technology likely to become available to the end user (industry, farmer,

other scientists)? What are the constraints, if known, to the adoption durability of the technology?

In December 1998, AIPL received a Government Technology Leadership Award from Government Executive magazine for enhancing genetic improvement for milk yield by reducing generation interval. The annual award recognizes the efforts of Federal organizations to communicate and to apply new technologies.

Genetic evaluations for 11.7 million U.S. dairy animals (cattle and goats) for yield (milk, fat, protein, and component percentages) traits and

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economic indexes (milk, fat, protein, cheese yield, and net merit) based on those evaluations were distributed quarterly to 40,000 breeders, 100 AI organizations, 65 extension specialists, 6 DRPC's, and 9 breed associations as well as to researchers in the United States and over 40 foreign countries as a primary source of information for direct use in selection decisions on purchase of semen, embryos, and animals domestically and internationally. Evaluations also were provided to Interbull for inclusion in international evaluations.

Web and file transfer protocol sites for AIPL were expanded and enhanced so that genetic evaluation information is distributed electronically through the Internet. This electronic transfer system includes access to common files available to the public as well as organization-specific files with password protection. An improvement to the web site is the ability to conduct queries for bull evaluations based on the partial name of the bull rather than just registration number. Also available through the web site are electronic versions of recent AIPL memorandums and factsheets on changes in the genetic evaluation system, participation in recordkeeping programs, yield information for U.S. dairy cattle and goats, and DRPC activity as well as general AIPL information (personnel, mission, publication lists, computer formats for data exchange, and descriptions of data file characteristics) and links to other dairy industry sites.

Genetic evaluations for 114,807 Holstein cows and 3,977 of their sires based on data from Holstein-Friesian de Mexico, Queretaro, Mexico, were transferred to Holstein-Friesian de Mexico for distribution to the Mexican dairy industry to provide information to dairy producers for making breeding decisions to increase the rate of genetic improvement for milk yield and efficiency in their herds.

Multinational bull evaluations and conversion formulas between the United States and 22 countries were computed in cooperation with Interbull for five breeds and made available for individual bull or file access on the Internet for use in national and international breeding and marketing decisions.

As part of a collaborative effort with GEML on detection of genes that have a major effect on milk and yield components, genotypic data and genetic evaluations were used to identify regions in the genome that

relate to economically important genetic differences. This research has been supported by AI organizations through semen donations. Genotypic data for application to genetic selection decisions have been delivered to those organizations.

8. List your most important publications and presentations, and articles written about your work (up to three total--NOTE: this does not replace your reviewed publications which are listed below)

Interbull shows how U.S. bulls stack up. Agricultural Research, p. 16.

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February 1998.
Anderson, C. (AP farm writer). Service aims to find best. Star Beacon, p. C5. March 9, 1998.
Powell, R.L. International genetic comparisons: current and future efforts to rank bulls accurately across countries. Annual CRI Latin American Sales Conference, Ithaca, NY. September 1, 1998.

PUBLICATIONS:

01.
POWELL, R.L., WIGGANS, G.R. and NORMAN, H.D. 1998. Equity of elite cow status across states. J. Dairy. Sci. 81:2518-2523.

02.
POWELL, R.L. and NORMAN, H.D. 1998. Use of multinational data to improve national evaluations of Holstein bulls. J. Dairy Sci. 81:2257-2263.

03.
MEINERT, T.R. and NORMAN, H.D. 1998. Merit of outliers for milk yield as indicators of accuracy of genetic evaluations of sires. J. Dairy Sci. 81:2951-2955.

04.
VANRADEN, P.M. 1998. Best prediction of lactation yield and persistency. Proc. 6th World Congr. Genet. Appl. Livest. Prod. 23:347-350.

05.
NORMAN, H.D., WRIGHT, J.R. and CLAY, J.S. 1998. Comparison of the test interval method with best prediction for estimating lactation yield. Proc. 6th World Congr. Genet. Appl. Livest. Prod. 23:343-346.

06.
KEOWN, J.F., MONTALDO, H., VAN VLECK, L.D. and VAN TASSELL, C.P. 1998.

Economic responses and risk from use of selected Holstein sires in ...
USA. Proc. 6th World Congr. Genet. Appl. Livest. Prod. 23:327-330.

07.
BERTRAND, J.K. and WIGGANS, G.R. 1998. Validation of data and review of results from genetic evaluation systems for US beef and dairy cattle.
Proc. 6th World Congr. Genet. Appl. Livest. Prod. 27:425-432.

08.
VAN TASSELL, C.P., MISZTAL, I. and VARONA,L. 1998. Method R estimates of heritability, repeatability, and dominance fraction of variance for milk,
fat, and protein yields of Holstein dairy cattle. J. Dairy Sci. 81(1):70.

Publications: (Continued)

09.
MISZTAL, I., ... and VAN TASSELL, C.P. 1998. Studies on the value of incorporating effect of dominance ... dairy cattle, beef cattle, and swine. Proc. 6th World Congr. Genet. Appl. Livest. Prod. 25:513-516.

10.
VANRADEN, P.M. and HUBBARD, S.M. 1998. Development of economic indexes for net merit, fluid merit, and cheese merit. J. Dairy Sci. 81(1):83.

11.
POWELL, R.L. and HUBBARD, S.M. 1998. Improved prediction of national genetic evaluations by including international information. J. Dairy Sci. 81(1):83.

12.
VANRADEN, P.M., SMITH, L.A., WOLFE, C.W., WILK, J.C. and MCDANIEL, B.T. 1998. Calculation of expected inbreeding percentage of future progeny. J. Dairy Sci. 81(1):67.

13.
NORMAN, H.D., WRIGHT, J.R. and CLAY, J.S. 1998. Comparison of test interval and best prediction methods for estimation of lactation yield from monthly, a.m.-p.m., and trimonthly testing. J. Dairy Sci. 81(1):56.

14.
PHILPOT, J.C., WIGGANS, G.R. and VAN TASSELL, C.P. 1998. Use of the World Wide Web to distribute genetic evaluations. J. Dairy Sci. 81(1):62.

15.
WIGGANS, G.R. and HUBBARD, S.M. 1998. Genetic evaluation of yield and conformation traits of dairy goats. J. Dairy. Sci. 81(1):110

16.
POWELL, R.L. 1998. Improved prediction of national genetic evaluations by including information from INTERBULL evaluations. Inter. Bull Eval. Serv. Bull. No. 17:37-39. Dept. Anim. Breeding and Genet., SLU, Uppsala, Sweden.

17.
NORMAN, H.D. and POWELL, R.L. 1998. Dairy cows of high genetic merit for yields of milk, fat, and protein. Proc. 8th World Congr. Anim. Prod. 2:167-176.

18.
POWELL, R.L. 1998. International genetic comparisons: current and future efforts to rank bulls more accurately across countries. Proc. Natl. Dairy Genetic Workshop, Orlando, Florida pp. 95-101.

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WIGGANS, G.R. 1998. What's changing in genetic evaluations...data, model dissemination. Proc. Natl. Dairy Genetic Workshop, Orlando, Florida pp. 47-53.

Publications: (Continued)

20.
POWELL, R.L. 1998. Frequency of genetic evaluations: two times per year vs 4 times per year. Red Bloodlines 21(March):12.

21.
SIEBER, M., POWELL, R.L. and HUBBARD, S.M. 1998. International genetic evaluations: don't let the numbers confuse you! Holstein World 95:30, 32.

Approved: D.F. COLE Date: 02/99
Title: ACTING ASSOCIATE DIRECTOR

***OFFICIAL***

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Title: DEVELOP AND IMPROVE GENETIC EVALUATIONS FOR FITNESS TRAITS TO INCREASE EFFICIENCY DAIRY CATTLE

Period Covered From: 01/98 To: 08/98

Progress and Outcomes:

1. What major problem or issue is being resolved and how are you resolving it?

The intense and effective selection for high milk and component yields practiced in the United States for 30 years has raised individual animal yields to record levels and placed stress on dairy animals because of lack of commensurate genetic improvement in traits that support high yield. Knowledge of the relationships between fitness traits and lifetime yield due to their effect on involuntary culling was refined to allow design of optimum breeding programs that will maximize profitability for U.S. producers.
Mastitis causes serious economic losses, and genetic control of mastitis is necessary to improve resistance to mastitis in future generations. This can be accomplished through genetic evaluation and selection for reduced somatic cell score of milk, which is one indicator of mastitis. Genetic evaluations for dairy cattle were developed and made available to the dairy industry.
Many dairy producers worry that cows bred to give large volumes of milk may not stay in a herd because adequate selection has not been directed to other supporting traits. Productive life evaluations were developed and improved by including information from correlated traits (yield, conformation, and mastitis resistance) expressed earlier in life.
The individual genes that influence important traits of animals are becoming much easier to identify and to use in selection programs. Numbers of quantitative trait loci (QTL's) and the size of their effects have yet to be determined. The Laboratory is investigating the association between productive life, mastitis resistance, and reproductive performance and genetic markers to identify QTL's and is developing methodology to utilize such information in genetic

evaluations.

2. How serious is the problem? Why does it matter?

Annual cost of mastitis in lost milk in the United States is about $1 billion per year. Treatment costs and losses due to culling raise the cost of mastitis to $1.5 to $2.0 billion per year. A large payoff is possible through effective mastitis control.
Value of dairy cattle (including semen and embryos) is affected by fitness traits, especially those shown to be linked to increased profit.

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It is important to provide research results that enable U.S. dairy producers and industry personnel to make informed decisions about conformation, health, and longevity characteristics of animals from foreign sources relative to our own.

3. How does it relate to the National Program(s) and National Program Component(s) to which it has been assigned?

National Program 101, Animal Germplasm, Resources, Conservation and Development (100%). This research allows more accurate and rapid identification and characterization of dairy animals with potentially useful germplasm for improved fitness traits to support yield efficiency, increased productive life, and improved resistance to mastitis. Genomic maps and their associated DNA markers are being developed to improve the accuracy of selection for mastitis resistance and conformation traits, increase the frequency of desirable genes in populations, and characterize valuable germplasm populations.

4. What was your most significant accomplishment this past year?

Recent advances in computation of genetic evaluations for conformation of dairy cattle have included multitrait analysis and the use of animal models. Those advances were used to evaluate more accurately the genetic merit of U.S. dairy cattle for conformation traits. Data included final scores and scores for 15 linear type traits (stature, strength, dairy form, foot angle, rear legs side view, body depth, rump angle, thurl width, fore udder attachment, rear udder height, rear udder width, udder depth, udder cleft, front teat placement, and teat length). Genetic parameters needed to calculate evaluations were estimated, and a method to adjust data for the effects of age at appraisal was developed. The statistical model for evaluations included the effects of an animal's genetic merit, its permanent environment, and the interactions of herd and sire; herd, appraisal date, and parity; parity and appraisal age; and parity and lactation stage. The system developed was implemented in the United States in February 1998 for the genetic evaluation of type

traits of Ayrshires, Brown Swiss, Guernseys, Jerseys, Milking Shorthorns, and Red and Whites. The improved evaluations will provide more accurate information on which breeders can base selection decisions for type traits of economic importance to them.

5. Describe your major accomplishments over the life of the project, including their predicted or actual impact

Genetic evaluations for somatic cell score, an indicator of mastitis, were developed based on lactation records from dairy cattle across the

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United States. Routine release of these evaluations to the dairy industry began in January 1994 for bulls and in July 1995 for cows. Dairy producers that use these evaluations to select for mastitis resistance receive direct economic benefits through higher milk quality premiums and also reduce the need for antibiotic therapy in their herds, thereby decreasing the risk of dairy product contamination, ensuring milk quality, and enhancing the health of their cattle.

Methods were developed to evaluate dairy cattle genetically for their productive life based on national data from the animal and all its relatives (living and dead). Routine release to the dairy industry of these evaluations began in January 1994 for bulls and in July 1995 for cows. Genetic evaluations for productive life allow U.S. dairy cattle breeders to select more directly for longevity and to monitor the progress or decline in their animals' genetic merit, thereby increasing their economic progress by up to 4% and enhancing animal welfare.

In January 1994, the Laboratory computed a new economic index for bulls called "net merit," which combines genetic merit for yield adjusted for feed cost, productive life, and somatic cell score. In July 1994, the Laboratory and Holstein Association USA worked together to improve productive life and net merit rankings by combining correlated information from type, yield, and culling data into an improved productive life evaluation with higher reliability. Percentile rankings for bulls now are based on net merit instead of the previous economic index based on gross values of milk, fat, and protein. Net merit indexes became available for cows for the first time in July 1995.

At a genetic level, mastitis and milk yield are associated, which has aroused concern that continued selection for high milk yield may increase the incidence of mastitis. To identify markers that predict a low incidence of somatic cells (an indicator of mastitis) in milk, five chromosomes were studied in seven three-generation Holstein families. Based on results from the five chromosomes studied, the gene with the largest significant effect for reducing mastitis incidence was linked to markers on chromosome 23.

A major gene or QTL was identified in an important Holstein family. This QTL appears to allow for selection to increase body reserves without

altering milk yield, which is desirable because increased reserves likely would reduce the incidence of metabolic disorders.

Results of this research effort benefitted all segments of the dairy industry and the public through increased disease resistance and profitability of dairy animals. Competitiveness of U.S. dairy farms was enhanced for worldwide exports of U.S. dairy animals, embryos, and semen. All U.S. consumers of milk and dairy products have benefitted by having a more economical and higher quality food source than would otherwise be available. Increased efficiency through genetics has helped keep the farm price of milk at the same level as 20 years ago.

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6. What do you expect to accomplish during the next year?

This project was terminated on August 23, 1998. A new proposal is being prepared that merges some of the general objectives of this project for fitness-related traits with a recently terminated project with similar objectives for yield efficiency. Objectives of the new project include the maintenance of a national database for genetic research on milk yield, composition, and fitness traits that is accessible for domestic and international research and industry needs; development of improved methods for comparison of genetic evaluations across countries so that producers have equitable information from all sources, especially from Interbull; investigation of the accuracy of alternative methods of genetic evaluation, especially the use of test-day observations, and comparison with the accuracy of current methods; determination of the economic values of health and reproductive traits and development of measures of overall merit that include those traits; and identification of genetic markers and determination of the feasibility of their use to improve the accuracy of evaluated traits and prediction efficiency.

7. What technologies have been transferred and to whom? When is the technology likely to become available to the end user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption durability of the technology?

Genetic evaluations for 11.7 million U.S. dairy animals (cattle and goats) for fitness (mastitis resistance, longevity, and conformation) traits and economic indexes (production-type and net merit) based on those evaluations were distributed quarterly to 40,000 breeders, 100 artificial-insemination organizations, 65 extension specialists, 6 DRPC's, and 9 breed associations as well as to researchers in the United States and over 40 foreign countries as a primary source of information for direct use in selection decisions on purchase of semen, embryos, and animals domestically and internationally.
Laboratory web and file transfer protocol sites were expanded and

enhanced so that most genetic evaluation information is distributed electronically through the Internet. This electronic transfer system includes access to common files available to the public as well as organization-specific files with password protection. An improvement to the web site is the ability to conduct queries for bull evaluations based on the partial name of the bull rather than just registration number. Also available through the web site are electronic versions of recent Laboratory memorandums and factsheets on changes in the genetic evaluation system, participation in recordkeeping programs, information on conformation and mastitis resistance traits for U.S. dairy cattle and

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goats, and DRPC activity as well as general Laboratory information (personnel, mission, publication lists, computer formats for data exchange, and descriptions of data file characteristics) and links to other dairy industry sites.
As part of a collaborative effort with the Gene Evaluation and Mapping Laboratory on detection of genes that have a major effect on conformation, calving ease, productive life, and mastitis resistance, genotypic data and genetic evaluations were used to identify regions in the genome that relate to economically important genetic differences. This research has been supported by AI organizations through semen donations. Genotypic data for application to genetic selection decisions have been delivered to those organizations.

8. List your most important publications and presentations, and articles written about your work (up to three total--NOTE: this does not replace your reviewed publications which are listed below)

Gengler, N., et al. Genetic evaluations for color breeds. Guernsey Breeders' Journal, p.144. March 1998.

PUBLICATIONS:

01.
WEIGEL, K.A., LAWLOR, JR., T.J., VANRADEN, P.M. and WIGGANS, G.R. 1998. Use of linear type and production data to supplement early predicted transmitting abilities for productive life. J. Dairy Sci. 81:2040-2044.

02.
ASHWELL, M.S., DA, Y., VANRADEN, P.M., et al. 1998. Detection of putative loci affecting conformational ... population of United States Holsteins using microsatellite markers. J. Dairy Sci. 81:1120-1125.

03.
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