Improving dairy animals by increasing accuracy of genomic prediction, evaluating new traits, and redefining selection goals
ARS 8042-31000-002-00-D
Milestones

Project Title	Improving Dairy Animals by Increasing Accuracy of Genomic Prediction, Evaluating New Traits, and Redefining Selection Goals
Project No.	8042-31000-101-00D
National Program	101: Food Animal Production

Objective	1 - Expand genomic data used in prediction by selecting new variants that more precisely track the true gene mutations that cause phenotypic differences.
NP Action Plan Component	2: Understanding, improving, and effectively using animal genetic and genomic resources
NP Action Plan Problem Statement	2A: Develop bioinformatic and other required capacities for research in genomics and metagenomics; 2B: Characterize functional genomic pathways and their interactions; 2D: Develop and implement genetic improvement programs using genomic tools
Goal/Hypothesis	*Hypothesis:* Addition of new variants from sequence data will improve reliability of genomic predictions compared with that from single-nucleotide polymorphism markers currently used in genotyping arrays.

SY Team	Months	Milestone	Anticipated Product
Vacant, Van Tassell, VanRaden	12	Obtain whole genome sequence data for 200 additional Holstein and 50 Jersey bulls	New variants in U.S. dairy cattle not already discovered by global researchers
Cole	24	Routinely calculate gene content for nongenotyped cows for known Mendelian traits	Peer-reviewed publication; new information for distribution to animal owners
VanRaden, Vacant	36	Impute and select new variants from run 6 of the 1000 Bull Genomes Project	Revised genotyping arrays with additional variants that more closely track genetic effects
Cole, Vacant	48	Investigate potential to use edited genes or combine the best chromosomes into one animal by simulation	Peer-reviewed publication(s) on simulation study results
Vacant, VanRaden	60	Obtain and evaluate whole-genome sequence data for Brown Swiss, Ayrshires, Guernseys, and additional Jerseys	Breed-specific variants and improved prediction reliability for all breeds

Objective	2 - Evaluate new traits that can all be predicted at birth from the same inexpensive DNA sample.
NP Action Plan Component	1: Increasing Production and Production Efficiencies while Enhancing Animal Well-Being across Diverse Food Animal Production Systems; 2: Understanding, improving, and effectively using animal genetic and genomic resources
NP Action Plan Problem Statement	1A: Improving the efficiency of growth and nutrient utilization; 1B: Improving reproductive efficiency; 1C: Enhancing animal well-being and reducing stress; 2A: Develop bioinformatic and other required capacities for research in genomics and metagenomics; 2B: Characterize functional genomic pathways and their interactions; 2D: Develop and implement genetic improvement programs using genomic tools
Goal/Hypothesis	*Goal:* Determine if the national increase in economic progress is more valuable than the combined expenses of collecting data and computing genetic evaluations for several individual new traits.

SY Team	Months	Milestone	Anticipated Product
VanRaden	12	Evaluate gestation length as new trait	Genetic rankings distributed worldwide by the Council on Dairy Cattle Breeding
Cole, Vacant	24	Incorporate recessive traits into economic indexes	Genetic rankings for economic merit which account for Mendelian traits (e.g., polled) for industry use
Cole, VanRaden, Vacant	36	Estimate potential economic values and develop genetic rankings for additional new traits	Peer-reviewed publication on economics and genetic rankings of new traits; industry guidance on investment in data collection
	48	…	…
Cole, VanRaden	60	Update net merit formula with new traits and changing prices	Improved selection index for industry use

Objective	3 - Improve efficiency of genomic prediction and computation by developing faster algorithms, testing new adjustments and models, and accounting for genomic pre-selection in evaluation.	
NP Action Plan Component	2: Understanding, improving, and effectively using animal genetic and genomic resources	
NP Action Plan Problem Statement	2A: Develop bioinformatic and other required capacities for research in genomics and metagenomics; 2B: Characterize functional genomic pathways and their interactions; 2D: Develop and implement genetic improvement programs using genomic tools.	
Goal/Hypothesis	*Hypothesis:* Developing, testing, and implementing new computational methods can improve accuracy with little extra cost or provide the same or similar accuracy with reduced cost.	

SY Team	Months	Milestone	Anticipated Product
VanRaden, Vacant	12	Apply new algorithms in Findmap and Findvar software to large-scale cattle sequence data	New software to manage rapidly growing data efficiently
Cole, VanRaden	24	Evaluate crossbred animals by combining purebred marker effects weighted by breed composition	Peer-reviewed publication on genomic evaluation of crossbred cattle; new technology to transfer to Council on Dairy Cattle Breeding
Cole, Vacant	36	Determine optimal combinations of directly measured and correlated phenotypes for novel traits	Peer-reviewed publication
VanRaden, Vacant	48	Develop and compare prior information for weighting different types of variants (markers vs. quantitative trait loci)	Software; improved genomic evaluations
VanRaden, Vacant	60	Test potential bias in trait evaluations caused by genomic preselection of mates, progeny, and herdmates	Peer-reviewed publication on genomic evaluation bias caused by preselection; possible revisions in genetic evaluation software