

Symposium: Breeding and Genetics: Training of Future Animal Breeders

169 Training graduate students in animal breeding: A historical perspective. E. J. Pollak*, *Cornell University, Ithaca, NY.*

The training of animal breeding students has historically been based on the blending of information from basic and population genetics, statistics, and animal science. Statistics provided breeding students with the foundation in methods of estimation of effects and variance components and modeling strategies for varying types of phenotypes (e.g., continuous, categorical or survival data). Genetics provided foundations in understanding of the biology of inheritance, of additive and nonadditive effects and population theory for selection. Animal science provided the biological understanding of traits within our domestic species of interest as well as insight into industry needs, management practices, and constraints. The advent of a computer science curriculum provided for the skills to develop computational tools for analysis of data to meet research needs, especially in cases where large volumes of data are analyzed. Concepts and tools from these disciplines were brought together in animal breeding courses that focused on developing and implementing strategies for genetic assessment, selection and mating plans. What changed over the decades of training students in animal breeding were not the foundation disciplines but rather the nature of the information gleaned from those disciplines and from the changes in technology for implementing animal breeding plans. Focus in this presentation will be on understanding the history of educating animal breeding students in quantitative genetics theory with an eye on how this history should guide us into the future given the impending large impact of molecular biology on animal agriculture and particularly on opportunities for application in animal selection.

Key Words: Training, Animal Breeder, Quantitative Genetics

170 Graduate education utilizing distance learning. R. M. Lewis*¹, B. B. Lockee¹, M. S. Ames¹, R. M. Enns², J. M. Rumph³, T. W. Wilkinson¹, and E. J. Pollak⁴, ¹*Virginia Tech, Blacksburg*, ²*Colorado State University, Fort Collins*, ³*Michigan State University, Lake City*, ⁴*Cornell University, Ithaca, NY.*

Graduate-level education in animal breeding and genetics is in a state of dilemma: there are too few faculty members with expertise in this discipline at individual institutions to provide comprehensive training. A potential solution is an inter-institutional distance education curriculum. A consortium of universities is attempting to address this challenge by developing seven online courses to supplement Masters degree-level instruction in existing degree programs. The choice of courses was based on a national survey. In total 125 faculty members from 46 land-grant institutions were contacted, and nearly 50% responded. Feedback was sought on the extent and comprehensiveness of graduate-level training in breeding and genetics at their institution, and whether modularized online courses might offer a vehicle for addressing gaps in their program. Ninety-three percent of respondents believed online courses were an acceptable method to deliver advanced training, and 86% believed that a comprehensive distance learning curriculum was needed. The ADDIE instructional design model - analyze, design, develop, implement, evaluate - is being used for course construction. Evaluation is

central. In addition to student evaluations, each course will undergo review by four content experts, two from outside the consortium, and a specialist in instructional design. In order to be sustainable, the curriculum requires an organizational infrastructure. Thus, another aim is to coordinate partner institutions in the accreditation, delivery and cost-recovery of the resulting curriculum. The structure established will be designed to encourage participation of other institutions in the development of additional distance learning courses. Thus far two courses have been prepared, with one taught and the other in progress. Twenty students from 11 universities have participated in each course. Feedback has been very positive. The inter-institutional sharing of distance education programming appears to be a viable strategy to meet student, industry and academic needs for advanced training in animal breeding and genetics.

Key Words: Graduate Education, Distance Learning, Breeding and Genetics

171 Challenges of training quantitative graduate students. I. Misztal* and J. K. Bertrand, *University of Georgia, Athens.*

Acute shortage of quantitative geneticists (QG) in animal breeding has occurred in the U.S.; therefore, despite recruiting efforts, including those by professional companies, demands are not met. This is because the supply of quality graduates is low.

The QG shortage is partly a result of a past shift in funding from quantitative to molecular genetics. Consequently, new types of training were needed, notably in lab techniques. Now, as the molecular information becomes available through commercial products, the lab experience is less important, and the training required by current molecular geneticists has de facto become similar to those of quantitative geneticists. In particular, future success in the hot area of genomic selection will be largely dependent on scientists with quantitative skills: manipulating the genomic information requires quantitative skills and good genomic EBV requires good conventional EBV.

Several steps should be taken to provide more and talented graduates for animal breeding in QG. Currently, the supply of QG Ph.D. candidates is limited and those applying often have limited background and motivation. One way of increasing the number of U.S. candidates is to substantially raise scholarships, at least to a level comparable to that paid at EU institutions. Many generic courses fail to excite students and specialized courses with low enrollment lack the critical mass. Replacement of these courses by short courses with specific focus can provide strong motivation to excel due to peer competition, while also creating a social environment among graduates from different institutions. As a student can easily be overwhelmed by too many courses, some semesters need to be designated for short courses only, and a mechanism to provide credits to students from non-home institutions needs to be worked out. Finally, much larger competitive, special grants, and industry (including matching funds) QG funding should be made available to interested faculty, to provide incentives to departments to retain and hire more QG faculty.

Key Words: Quantitative Genetics, Graduate, Training

172 Alternative teaching techniques for new and smaller animal breeding programs. C. D. Dechow*, *Penn State University, University Park.*

Animal breeding programs at many universities consist of one or two faculty members who also have a large undergraduate teaching or extension appointment. A small number of animal breeders within a department combined with limited support for their research program create obvious teaching challenges. Effective upper level animal breeding courses require a critical mass of students and if all animal breeding courses are taught by the same instructor, the curriculum focus can be limited. Animal breeding students might also feel isolated because of limited interaction with other animal breeding students. There is a strong demand for well trained animal breeding students despite these challenges and faculty members must pursue alternate avenues to train students. The challenges associated with low course enrollment have led to the development of online animal breeding courses that are recently available. While online courses alone will not satisfy all teaching needs, they will help fill the classroom void. Alternative teaching or learning techniques are not limited to online courses. Short courses and professional meetings provide learning opportunities and interaction with other faculty and future animal breeders. Many students would benefit from a semester spent studying abroad or at a peer institution with a larger faculty and student base in animal breeding. An example program is the Traveling Scholar Program of the Committee on Institutional Cooperation, which facilitates tuition and stipend payments for graduate students studying at different Big Ten universities. Partnerships between industry and university faculty can provide support for graduate training while exposing students to practical industry research needs. Finally, undergraduate student research and honors projects can be an effective tool to generate interest in animal breeding and complete small research projects with limited cost. The landscape for training animal breeding students has changed. There are new challenges to overcome, but tools to meet those challenges are in place and small animal breeding programs can help provide tomorrow's animal breeders.

Key Words: Animal Breeding, Teaching

173 Quantitative genetics training to meet the needs of the breeding industry. M. M. Lohuis*, *Monsanto Company, St. Louis, MO.*

The supply of well-trained graduate students for quantitative genetics roles in the plant and animal genetics industries is not keeping up with demand. With the apparent reduction in supply/demand, breeding companies are now also hiring graduates with degrees in statistics, bioinformatics and computer science into quantitative genetics roles traditionally held by animal or plant breeding graduates. Although, the breeding industries continue to consolidate, and reliable and comprehensive software packages are increasingly available, the demand for quantitative geneticists is remaining constant or increasing. Breeding companies continue to run breeding programs that require data manipulation, variance component estimation and genetic evaluations. However, they are also adding new dimensions to their programs that can involve the incorporation of genetic marker data, longitudinal data and/or more complex mixed models. With the availability of relatively affordable SNP multiplex genotyping platforms, very large datasets (i.e. greater than 150M SNP data points) are becoming more commonplace. Simultaneously, considerable work is required for optimization, simulation and breeding strategy to make these high-dimension breeding programs tractable and profitable in an industry setting. Traditional strengths of quantitative genetics graduates continue to be solid training in quantitative genetics principles, applied statistics, selection theory and computing skills. Traditional shortcomings tend to be limited knowledge of molecular and structural/functional genomics, inconsistent training in bioinformatics and breeding strategies and a lack of collaborative research and networking skills. Demand continues to grow for quantitative genetics graduate students that have a comprehensive knowledge of both quantitative and molecular genetics principles and techniques, together with the ability to collaborate with scientists from related fields and continue to grow and adapt to new technologies as they develop.

Key Words: Training, Genetics, Breeding