UF-Gainesville Beef Cattle News Corner

Looking ahead – opportunities for genetic improvement contributions to sustainable animal industries.

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Currently, more than 7 billion people inhabit our planet, and it is predicted we will reach 9.6 billion by 2050. Food demand is expected to increase by 49% and will be driven by population growth and rise in income in low-income countries. But this increased demand has to be realized sustainably, with the goal of balancing economic viability, environmental responsibility and social acceptability. Improving productivity and efficiency so that more meat and milk can be produced with fewer resources is the way livestock producers will insure sustainability. Because consumers are increasingly questioning the way food is produced, the producers will have to demonstrate their dedication to environmental responsibility. Although environmental responsibility encompasses multiple issues, the focus to date has been on greenhouse gas (GHG). US livestock industries made considerable progress in cutting resource use and GHG emissions over time. US beef production in 2007 required 19% less feed, 33% less land, and 12% less water and had a 16% reduction in GHG emission per kg of been compared with production in 1977. This was accomplished through improved cattle growth rates, slaughter weights and crop yields.

Genetic improvement has the unique advantage of driving changes in a population which are both permanent and cumulative. These attributes place genetic improvement at the core of the sustainability pathway endorsed by the animal industries in response to consumer concerns and the need to be socially responsible and demonstrate stewardship of natural resources. Increased productivity without an increase in resources used, is the best strategy to meet global dietary needs affordably and sustainably and minimize the negative environmental impact of livestock. The most effective way to accomplish this is a balanced selection, targeting animal production, health, fertility and environmental impact. However, genetic improvement is a lengthy process and is not inexpensive. The cost of measuring the phenotypes of interest and implementing a selection program could exceed the benefits expected from improving a population. The impact of within-breed selection, estimated to generate typical annual genetic gains of 1-3%, had a significant impact on the productivity of many animal industries. Two examples stand out: improved genetics contributed about 50% of the increase in the average annual milk yield per cow in the United States from 1,890 kg in 1924 to 9,682 kg in 2011, and the time for broiler chickens to reach market weight decreased threefold between 1957 and 2001.

Productivity is at the heart of creating a sustainable food system. Advances in genetics, nutrition and disease control have been driving the tremendous increases in global livestock productivity witnessed since 1960. Increases of 20-30% have been estimated for carcass weight of meat-producing animals, milk yield of dairy cows and egg production. Advances in reproductive technologies like artificial insemination and embryo transfer used along with

within-breed selection allowed the efficient dissemination of elite animals' genomes resulting in spectacular genetic improvements. Genetic improvement through selective breeding from the 1960s to 2005 lead to 50% increase in litter size in pigs, 37% increase in lean pork meat and the amount of lean pork meat doubled for the same feed intake. In poultry, genetic improvement resulted in 12 to 20% increase in breast meat, decrease in the number of days required to reach 2 kg from 100 to 40 days and 80% increase in the number of eggs per ton of feed. Since the implementation of genomic selection in many livestock industries, the rates of genetic change have been estimated to be around 20 to 30%. While the traditional focus in selection programs in developed countries has been on increasing production, there are many pressures and concerns associated with animal production.

Consumers today demand high quality products while still maintaining the lowest possible production cost, and that animals are raised in a sustainable manner with great attention being paid to increased welfare and reduced environmental footprint. The estimated increase in the world's population from 7.6 billion people to 10 billion by year 2050 will create enormous challenges to securing an abundant and safe food supply. Advances in genomics technology and research can be part of the solution by allowing further improvement in animal productivity, disease resistance, adaptability to increased climate variability (e.g., heat, drought, rainfall), improved nutritional quality while minimizing environmental impact.

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Genetics, selective breeding and genomics transformed livestock production and health which had a tremendous impact for both farmers and consumers. Supported by advances in genomic tools and reference datasets, genomic selection has been, and still is, adopted worldwide, and is predicted to intensify the improvements in target traits in multiple species and across various production systems. New genome editing technologies promise to fulfill opportunities of increasing livestock production efficiency in the developing world, improving animal health and welfare, alleviating the effect of climate change by increasing the heat tolerance of livestock, reducing the amount of methane and waste in current production systems, while improving consumer trust and acceptance.