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Conducting trials in the breeding herd

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Approaches to pork production research

Agricultural producers aspire to a more thorough understanding of the biology of their production system so that they can manage that system with optimal efficiency. A wealth of data collected under a variety of conditions is required to gain a full understanding of an agricultural system like pork production. Typically, data is collected under tightly controlled conditions at universities or research institutes, in controlled studies conducted at production units (on-farm research), through retrospective analysis of commercial production records, and as testimonials from practitioners in commercial production and research settings. Each of these approaches possesses inherent strengths and weaknesses.

Experiments conducted at universities and research institutes have the primary advantage of strict control over most variables that might affect the outcome of the experiment. This level of control allows investigators to gain a fair degree of certainty that the observed responses are attributable to the treatments imposed and not due to some unseen difference between the control and treated animals. These unseen differences are called confounding variables. In other words, characteristics of the population being studied (e.g., genetic line, age, health status, nutritional history, etc.) and the environment in which the experiment is conducted (e.g., ventilation rate, pen or crate design, season, geographical location, etc.) are tightly controlled so that these potential confounders do not create a difference between control and treated animals. Strict control of experimental conditions is very costly, so typically a small number of animals relative to commercial production systems are involved in the experiment. In addition, tight control of confounding variables creates a somewhat "artificial" situation that may not be reflective of commercial production systems where the results may be applied.

On-farm trials or field trials are often conducted at farms involved in commercial production. One can easily argue that this setting provides the true test of whether a management practice or treatment has any utility. One may conclude that if the intervention works in this scenario—with all the inherent variation present in the system—then the intervention truly is efficacious. This conclusion can only be accepted if one is fairly certain that coincident changes in some unseen factor (a confounding variable) could not be responsible for the observed response—for instance, the performance of a new feeder for lactating sows is compared to that of existing feeders in the farrowing quarters and determined to be superior. One could easily conclude that the design of the new feeder is better suited for lactating sows than the existing feeder. In reality, the new feeder may not be a better design. The new feeder simply may be operating properly because it is new and the existing feeders are old, worn, and not working properly. In this instance, maintenance of the existing feeder may have a larger influence than feeder design when it comes to selecting the superior feeder. Differences in condition of the two feeder types is a confounding variable.

Retrospective analysis of commercial production data provides a useful tool to gain insight into relationships among production variables. Large numbers of observations over extended periods of time are characteristic of this type of analysis. The investigator cannot control confounding variables and may have limited information to adjust for these confounders in the statistical analysis. Nonetheless, apparent relationships among production variables identified in retrospective analyses can be tested with carefully designed prospective treatments imposed in controlled university or on-farm experiments.

Testimonials provide interesting observations of a pork production system's response to a change and suggest possible factors that might influence a pork production system. If observed in a variety of production systems, these factors may merit further investigation in more controlled trials. Testimonials have varying degrees of validity and are clouded by personal biases of the observer.

Pork producers and industry professionals seem to have an intense interest in on-farm research. This interest stems, it would seem, from the fact that experiments are conducted in their facilities so the results are tailored to their production systems. Furthermore, tangible results are generated that producers can see and experience personally. The central question is: are the results valid?

Guiding principles for valid on-farm experiments

Adhere to principles of scientific inquiry

The primary objective of on-farm research is to obtain a valid, defensible answer to the question being studied in a commercial production setting. To arrive at a valid conclusion, one must adhere to basic principles of scientific inquiry. A full discussion of these principles is beyond the scope of this paper. The reader is referred to other authors for a more complete discussion of these basic principles (Reese and Stroup, 1992; Aaron and Hays, 2001). The investigator must select the proper experimental unit, which might be individual sows, pens of pigs, or a barn of animals. Treatments must be replicated or repeatedly assigned to similar experimental units in sufficient quantity to assure a reliable result. Statistical procedures are available to calculate the minimum sample size necessary to produce a reliable result with the desired sensitivity. In general, more replication is better than less; however, there is a practical limit to the time and labor that can be committed to an experiment. The marginal improvements in reliability and sensitivity decline after a threshold of replication is achieved.

Treatments must be assigned randomly to experimental units. Randomization is the principle that workers in commercial units most often compromise in the interest of convenience and ease of implementing the experimental protocol. For example, randomly selecting one row of gestation crates to house control sows and another row of crates for treated sows is not true randomization. One row may be nearer air inlets or cold outside walls or at the end of a feed line which would create a different environment and potentially a differential response to the imposed treatments. Although this approach may make record keeping easier, reduce the chances of misapplying treatments, and improve labor efficiency, the potential for confounded results is also fairly high which subverts the primary goal of the experiment.

Maintain integrity of commercial production system

The main reason for conducting on-farm research is to determine the response of animals housed and managed in commercial production systems. Consequently, the characteristics of the production system must be maintained to achieve this objective. If one implements all the principles of sound scientific inquiry so that there is strict control of nearly all of the confounding variables, the character of a commercial system is lost. In other words, one has created a controlled set of conditions similar to a university setting. The experiment is no longer meeting the "on-farm" objective.

Conduct of on-farm research is a constant balancing act between implementing principles of scientific inquiry and maintaining the characteristics of commercial production. Often, constraints in facility design, economics, and labor availability force one to compromise some of the principles of scientific inquiry. The investigator needs to judge whether these compromises will lead to unreliable conclusions.

Willingly commit labor and financial resources

Properly conducted on-farm research requires time to allot animals to treatments, impose treatments, collect data, and summarize data. A fully employed labor force in a commercial production unit cannot be expected to perform their regular duties and take on the additional duties required to conduct a research project. This challenge can be addressed by increasing the size of the labor pool or relieving some workers of lower priority duties during the period of the experiment. Either option has a price tag attached.

The phase of production and the nature of the experiment have a large influence on the labor and financial resources required. Nursery trials are relatively short in duration (4–6 weeks) and measure few variables, such as feed intake, weight gain, mortality, and morbidity. Growing-finishing trials are similar to nursery trials except that the duration is longer (16–20 weeks) and carcass data may be collected. In contrast, experiments in the breeding herd are rather long in duration and usually measure a large number of variables. Typically, sow trials last eight months to over one year and require workers to collect data on feed intake, sow weight, litter size, litter weight, piglet mortality and morbidity, sow mortality and morbidity, interval to estrus, and pregnancy rate. Nursery and growing-finishing experiments can be extended with repeated replications; even so, the volume of data generated is usually much less than that of experiments conducted in the sow herd.

Pay attention to details

The old saying "garbage in, garbage out" certainly applies to on-farm research. A properly designed experiment with a detailed protocol must be implemented without taking shortcuts or cutting corners. Deviating from the designed protocol introduces variables into the experiment that were not anticipated by, and may be unknown to, the investigators. Sometimes, conditions created by external forces such as disease, inclement weather, or unanticipated animal responses dictate a change in the protocol. A clear and honest discussion of the required changes and the reason for the changes among barn staff and investigators is necessary to ensure experimental integrity is maintained.

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