Selection Programs for Seedstock Producers

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Introduction

Seedstock producers require sound selection programs to ensure genetic progress for their customers. This fact sheet will aid seedstock producers in determining their selection objective(s) and how to make selection and culling decisions while managing risk. The concepts of performance testing, expected progeny differences (EPDs), accuracies and selection indexes will also be briefly reviewed. However, this is not a comprehensive publication on genetic improvement. The order of topics in this fact sheet are:

1. Determining selection objectives
2. Basics of performance testing
3. Expected progeny differences (EPDs)
4. Accuracies
5. Selection indexes
6. Making selection decisions
7. Selecting and culling sires
8. Selecting and culling females
9. Managing selection risk
10. Summary

Determining Selection Objectives

Seedstock producers should have well defined breeding goals and objectives for each breed or line of swine that they raise. These goals should fit the strengths (or niche) of each breed and be designed to meet specific needs of targeted markets. There are opportunities for different selection objectives based on various crossbreeding programs, marketing opportunities and production methods (confinement versus outdoor) used by potential customers.

The type of crossbreeding system being used by potential customers should be considered in deciding which traits to emphasize and which breeds and breed crosses to produce. Some commercial producers mate lean, fast growing boars (terminal sires) to prolific crossbred females (maternal lines) with all resulting pigs going to market. Other producers rotate several breeds of dual purpose sires in the production of market hogs and replacement gilts. Breeds used to produce terminal sires should emphasize postweaning traits. In maternal and dual purpose breeds, producers should select on a combination of reproductive and postweaning traits.

Unique marketing opportunities should also be considered. Opportunities exist to market pork that excels in meat quality. For breeds excelling in meat quality, producers should include this characteristic in their selection program along with other important traits.

In determining selection objectives, breeders might also consider the production methods used by potential customers. Total confinement with slatted floors, hoop structures with bedded floors, and outdoor farrowing are examples of some different production methods. A breeder selling animals to herds with sows on pasture might have a slightly different selection emphasis than a breeder who sells boars and gilts to confinement operations. For customers with pasture operations, the breeder might consider temperament as an additional trait in their selection program. Temperament would be important since their customers would need docile sows with good mothering instinct and requiring minimum care. These operations would also need active boars for pen mating on pasture.

Basics of Performance Testing

Seedstock producers need to produce the best breeding stock possible for their customers. To achieve this goal, an effective selection program is needed. Most selection programs include both within herd selection as well as selecting outside boars and semen. An effective within herd selection program must be well organized. Records should be collected on most of the herd and processed in a timely manner by a genetic evaluation program so it is possible to make meaningful comparisons. In selecting animals, meaningful comparisons are possible when breeders have properly designed contemporary groups.

A properly designed contemporary group includes animals that are of a common sex and environment. Contemporary groups should consist of at least 20 pigs from five litters and two or more sires. Ideally, one of these sires is used by other breeders, thus resulting in across herd genetic ties.

Across herd ties are important for accurate genetic evaluations. The purchase of semen is a common way to access these reference sires and provide for genetic ties among herds. Having a reasonable size contemporary group is important for reliable genetic evaluations. Furthermore, a contemporary group should have no more than a three-to four-week span in ages to help reduce environmental differences.

Equipment and techniques that allow collection of accurate records should be used. Accuracy of performance testing is improved by utilizing real-time ultrasound technicians that are certified by the National Swine Improvement Federation. Producers should use testing methods which consists of recording all litters and performance testing at least 50% of the pigs weaned. Records should be processed in a timely manner by genetic evaluation programs. Breeders should use records in selecting the best animals to replace lower ranking sires and sows. Finally, breeders should plan their mating to prevent inbreeding.

Expected Progeny Differences (EPDs)

For each trait measured by the breeder, adjusted performance records can be calculated. Examples of such records are adjusted number born alive, adjusted 21-day litter weight, adjusted days to 250 pounds, and adjusted backfat at 250 pounds. In the past, adjusted records were the only source of performance information used in selection. However, adjusted performance records are not always the best estimate of the animal's
breeding value. The animal's breeding value is that part of its genotypic value that is due to heritable gene effects. An individual receives half of its genes from the sire and half from the dam. Thus, a sire passes half of its breeding value to the progeny. Likewise, a dam passes on half of its breeding value to her progeny. One-half of the breeding value is referred to as the progeny difference. Each trait will have a progeny difference. Genetic evaluation programs process performance records to estimate progeny differences. The performance records on the individual as well as its relatives, siblings, parents and offspring (if available) are used in calculating an animal's expected progeny differences (EPDs). Expected progeny differences predict how well an individual's offspring should perform compared to progeny from average individuals in the genetic base year. An animal's EPDs may change over time and the base year for comparison may be adjusted. Comparisons should be made between individuals evaluated in the same time period.

Expected progeny differences are in actual units. The backfat EPDs are in inches, days to 250 EPDs are in days, number born alive EPDs are in number of pigs, and 21-day litter weight EPDs are in pounds. Positive EPDs are desirable for number born alive and 21-day litter weight. Negative EPDs are desirable for backfat and days to 250 pounds.

Accuracies

It is important to remember that expected progeny differences (EPDs) are “estimates” of genetic merit. Because EPDs are estimates, they will change with the input of new performance records into the genetic evaluation program. On some animals the EPDs may change very little from one year to the next while on other animals the EPDs may change greatly. The probability of EPDs changing is related to the accuracy. Accuracy measures the correlation between true breeding value and predicted breeding value. The closer the accuracy is to 1.0, the more likely the performance of offspring will be close to the EPD and less likely the EPD will change drastically with the addition of new information.

Genetic evaluation programs provide accuracy values which measure the reliability of EPDs. High accuracy EPDs are more reliable and are less likely to change with further evaluations. Producers can put more confidence in EPDs with high accuracies. If two boars have similar overall rankings but quite different accuracies (0.90 versus 0.20), use the high accuracy individual for more matings.

The size of the accuracy is related to the heritability of the trait and the amount of data used in calculating the EPD. With an equal number of records, a trait with high heritability (example – backfat) will have a greater accuracy than a trait with a low heritability (example – number born alive). This is because a higher heritability means that the observed differences in performance are more likely due to differences in genetics. Now let’s take a hypothetical example involving three boars to illustrate the relationship of the amount of data to the accuracy. Boar #1 was recently weighed off test and his EPDs were calculated based on his own records and the records available on all of his full sibs, half sibs, and parents. Boar #2 was also weighed off test but he was the only pig tested in his litter. Individual, half sib, and parental records were used in calculating his EPDs. Boar #3 is a sire with EPDs calculated based on his own record as well as the records of his siblings, parents, and 210 offspring. For these three boars, the accuracies will be the highest for boar #3 since he has sizeable number of progeny records. When calculating EPDs, each source of data affects the accuracy but progeny records have a greater impact. Boar #2 has the lowest accuracies since his EPDs were calculated with the least amount of data.

Selection Indexes

Number born alive, 21-day litter weight, days to 250 pounds, and backfat at 250 pounds are performance traits that are typically measured. A given animal will have an expected progeny difference (EPDs) for each of these traits. Each trait will also have a certain economic value. The selection index is calculated based on the economic weights and EPDs of the traits. The index value is the best estimate of the animal’s overall breeding value in terms of dollars and cents. Genetic evaluation programs provide index values.

The type of index used will depend upon the type of breed(s) you are raising and the intended use of your boars and gilts in commercial herds. Breeds can be grouped into three categories. Paternal or terminal breeds excel in growth rate and/or carcass traits. In commercial production, boars from paternal breeds are used to sire market hogs for terminal crosses and rotaterminal crossbreeding programs. Maternal breeds excel in litter traits and mothering ability. These breeds are used in the production of prolific replacement gilts for the terminal crosses and rotaterminal crossbreeding programs. A few breeds may fit into both the paternal and maternal categories. These dual purpose breeds can be used in rotational crossbreeding systems.

Three different selection indexes are used in swine genetic evaluation programs. The terminal sire index (TSI) is used for selection and culling in herds that have paternal or terminal breeds. This index includes only postweaning traits. The maternal line index (MLI) is used in maternal lines and dual purpose breeds for selection and culling purposes. The maternal line index includes both reproductive and postweaning traits but the reproductive traits receive twice as much economic emphasis compared to postweaning traits. The sow productivity index (SPI) ranks animals for only reproductive traits. This index is normally used for the purpose of culling sows on the basis of reproductive traits.

Making Selection Decisions

With genetic evaluation programs, producers can receive within herd reports and across herd sire summaries. Sire summaries can be used for comparing proven boars throughout a breed and within herd reports can be used for comparing animals within a herd. These reports provide producers with selection indexes, expected progeny differences (EPDs), and accuracies which are recalculated on a periodic basis due to the input of new performance data into the system. Index values (calculated at the same point in time) can be used for comparing animals throughout the herd and breed for selection purposes.

Selecting and Culling Sires. In selecting boars, first determine what are your selection goals so the proper index can be used in ranking animals. If you are selling boars as terminal sires, use the TSI. For breeding stock used in the production of replacement gilts or in rotational crossbreeding programs, use the MLI. Once an index is chosen and animals are ranked, a breeder should examine the visual traits of the higher indexing animals. Visual traits to be considered include underline, conformation, temperament (example – aggressiveness), reproductive soundness, and feet & legs. Select higher indexing animals with desirable visual characteristics. For breeds that excel in pork quality, some consideration should be given to this trait when selecting animals. Breeds used in niche markets often excel in pork quality. Measuring and using pork quality data in selection may be important to maintain or improve this characteristic in these breeds. Other breeds could also include pork quality in their selection programs. Since pork quality is not currently included in most indexes, it should be emphasized along with visual traits when making selections. Pork quality data is not always available. When pork quality data is available, use this information in selecting sires. Based on slaughter information, use progeny averages to compare sires. Two different schemes might be used in utilizing progeny data. With method #1 the breeder first identifies the sires with the best progeny averages for pork quality. From among these sires, next identify higher indexing boars with desirable visual traits. Once the final ranking is achieved, select semen or higher indexing sons from these sires. For the second method, the breeder identifies the highest indexing boars with desirable visual traits. From among those sires, identify boars with the better progeny averages for pork quality. Once the final ranking is achieved, select semen or higher indexing sons from these sires.

The accuracy of these comparisons will depend upon heritabilities and the number of progeny measured per sire. With moderate to high heritabilities and a reasonable number of progeny, the selection accuracy can be very good. For example, if the heritability is 0.50, five progeny would yield a 0.65 selection accuracy while 25 progeny would yield a 0.88 accuracy.

Breeders should select the highest indexing boars available (from within their herd as well as purchasing outside boars and semen). Since a breeder has first pick within his/her herd, they can be very selective. Thus, the selection intensity for home-raised sires should be high which will lead to rapid genetic progress. Index values can be used to compare animals of different ages throughout the herd. Thus, a newly tested boar can be compared to a proven sire. Breeders should select home-raised boars that have higher index values than their sires. Full and half sib matings, should be avoided so that the rate of inbreeding will be minimized. As previously stated, at least one reference sire should be used in each contemporary group.

Selecting outside boars is a way to introduce new genetics into a herd which will also help prevent inbreeding and provide genetic ties among herds. Across herd sire summaries can be an aid in selecting outside boars. First, identify high ranking boars in the summary. Next, visit the herds that are using these top ranking boars and use their within herd reports to select high indexing sons of these top sires.

Another source of outside genetics is purchased semen. Semen may be used to access top indexing boars (based on sire summaries). With purchased semen, a breeder can "test" sires in their herd without buying animals. If a particular A.I. sire produces high indexing offspring, a breeder can use that sire further or select a high indexing home-raised son.

Selecting and Culling Females. Sows are culled after weaning because of factors such as health, temperament, feet and legs, and poor mothering ability. Some sows are removed from the herd for other reasons or they fail to conceive. For culling based on performance, a suggested guide is to cull the poorest 20% of females based on the MLI or SPI. Index values are available from within herd genetic evaluation reports.

Determining number of gilts to select from a contemporary group can be estimated based on the average number of sows removed from each farrowing set. Number of sows removed from a farrowing set is equal to number of females culled plus the number that fail to conceive or are lost for other reasons. Producers can use past records to predict the average number of sows which will be removed from a farrowing group.

Gilts can be selected based on the TSI or the MLI depending on the breeder's selection goals. The higher indexing gilts can be examined based on visual traits. Select the higher indexing gilts with desirable visual traits. Because a large number of replacement females may be required, selection intensity on gilts will not be as great as with boars.

Managing Selection Risk. The risk associated with estimating true genetic value of a boar decreases with a higher accuracy. By using a high accuracy boar there is less risk that the index value will be very different from the individual's true genetic value. For example, a boar with a 0.40 accuracy and a 125 index has a 26% risk that he is truly under 110. In contrast, a well-proven boar (0.90 accuracy) with the same index has only a 7% risk that his true genetic value is less than 110. Utilizing accuracy values in selection can reduce the risk of selecting animals that will not perform as expected. Select proven and unproven sires with the highest index values. After making the selections, consider accuracy values as a way to manage the selection risk. One strategy of managing risk is to use young, unproven sires (which will have low accuracy values) for a limited number of matings while using proven, high accuracy boars more extensively. A second strategy is to equally use a group of young (low accuracy) boars and a few proven sires. Proven sires are needed to help provide genetic ties.

Using a group of unproven boars, rather than relying on one or two exceptional herd sires can substantially reduce the risk associated with using low accuracy animals. By using five young boars with an average index of 125 and an accuracy of 0.40 the risk is cut to just 7% that the average genetic merit of all five boars is truly below 110. Another consideration is that it is easier to find higher indexing young boars because of annual genetic progress. Thus, average index scores of a group of young boars will often be higher than that of a proven sire.

Both of these strategies reduce risk associated with selecting breeding animals. However, the second strategy of equally using a group of young boars and a few proven sires allows for greater reduction in potential risk and may offer faster genetic improvement. The general approach of risk management is to avoid using any one young boar too extensively. Some young boars selected may turn out to be very poor, but others may turn out to be better than expected. Regardless of accuracy, an index score is the best way of estimating the overall genetic merit of performance traits for each animal.

Summary

Seedstock producers try to produce the best breeding stock possible for their commercial customers by improving the overall genetic merit of their animals through selection. With any selection program, breeders should have well defined breeding goals and objectives for each breed of swine that they raise. These goals should fit the strengths (or niche) of each breed and be designed to meet specific needs of targeted markets. Based on their goals, the breeder can set up a selection program. An effective within herd selection program must be well organized. For meaningful comparisons, breeders must raise animals in adequate size contemporary groups that have a uniform environment. Performance records should be collected on at least 50% of the animals. Accurate records should be collected and they should be processed in a timely manner by using a genetic evaluation program. Genetic evaluation programs provide across herd sire summaries and within herd reports. For making selection decisions, within herd reports can be used for comparing all animals in the herd. Across herd sire summaries are used for ranking sires throughout the breed. From among the top ranking sires, breeders can select semen or high indexing sons. Within herd and across herd reports provide breeders with indexes, EPDs, and accuracies. Index values should be used in ranking animals for selection purposes. For example, high indexing young boars should be saved to replace lower indexing sires. Young high indexing gilts can be selected to replace low indexing sows. The terminal sire index should be used when producers' breeding objectives emphasize postweaning traits. For breeders wanting to improve reproductive and postweaning traits, they can use the maternal line index. To cull sows, breeders can use either the maternal line index or sow productivity index. Once animals are ranked using the terminal sire index or maternal line index, breeders can select higher ranking animals with desirable visual characteristics. All lines of pigs, but especially breeds excelling in pork quality, should use meat quality data along with index values and visual traits in selecting boars. Breeders should select semen or young boars out of sires that excel in pork quality while having higher index values and desirable visual characteristics. Accuracy values measure reliability of EPDs. The risk associated with estimating true genetic value of a boar decreases with a higher accuracy. By using a high accuracy boar there is less risk that the index value will be very different from the individual's true genetic value. Young, unproven boars will have low accuracies. However, breeders should select high indexing, young boars due to the annual genetic progress that occurs in most breeds. Due to the low accuracies on these boars, breeders should avoid using any one young boar too extensively. It is better to use a group of young boars along with a few proven sires as a way to reduce the overall selection risk. Sows are removed from a herd for a variety of reasons. Number of gilts selected from each contemporary group can be estimated based on number of sows removed from each group. In each contemporary group, select higher indexing gilts with desirable conformation traits.

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