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EC68-217 Selection and Crossbreeding for the Pork Producer

Leo Lucas

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SELECTION and CROSSBREEDING for the Pork Producer
Selection and Crossbreeding for the Pork Producer

By Leo E. Lucas
Agricultural Extension Livestock Specialist (Swine)

What Crossbreeding Can Do

★ Increase size of litter at farrowing (crossbred sows farrow larger litters)
★ Increase litter size at weaning (livability)
★ Increase growth rate

What Selection of Superior Performing Parents Can Do

★ Increase growth rate and efficiency of gain
★ Increase meatiness

What Selection and Crossbreeding Cannot Do

★ Overcome poor management
★ Replace sound nutrition and feeding
★ Replace good sanitation and disease control

Introduction

The goal of the commercial producer is to produce quality lean pork economically (Fig. 1). By selection of superior breeding stock and by crossbreeding, profits can be increased. This circular discusses procedures necessary for the producer to receive full benefits from his breeding program.

Three general areas of decisions will determine the effect of breeding in your herd. These are:
1. Breeding program (crossbreeding).
2. Boar selection.

Only by making accurate decisions in each area will the full benefit of your breeding program be obtained. A half-program is no better than none at all.

Crossbreeding

Crossbreeding is rather commonplace on most Nebraska hog farms. Ninety percent or more of the pigs marketed today are crossbred in one form or another. However, even with the large amount of crossbreeding being done, only a small percentage of producers are realizing the full benefits.

Crossbreeding is the mating of genetically different lines or breeds. The resulting increase in performance is called hybrid vigor or heterosis. It is measured as the percent superiority of crossbred offspring over the average of their parents.

Crossbreeding has several advantages over purebreeding, particularly for traits with low heritability estimates (Table 1):
1. In the individual pig, hybrid vigor increases growth rate and survival.
2. In the crossbred sow, hybrid vigor increases fertility, conception rate, litter size and survival of pigs.

However, crossbreeding will not materially increase:
1. Feed Efficiency: Feed efficiency is 35% heritable and can be improved by selecting boars with superior records of feed conversion.
2. Meatiness of Pigs: Carcass traits are highly heritable and can be improved by selecting parents with superior meatiness.

Caution: Crossbreeding swine in itself will not make your operation successful. Remember, all phases of hog production are necessary for success. Many producers fail with their crossbreeding program because of one of the following factors:

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The author wishes to acknowledge the help of the Cooperative Extension Services of Iowa State University and the University of Minnesota for the illustrations used in this circular. The cover picture showing the Crossbred Grand Champion boar at the 1965 International at Chicago is courtesy of Roy B. Keppy, Davenport, Iowa.
1. No system of crossbreeding.
2. Select inferior breeding stock.
3. Poor choice of breeds.

**Systems of Crossbreeding**

To realize the full benefits from a crossing program, you must follow a well planned system of breeding. You may use one of several crossbreeding programs. These programs vary in the number of breeds used, or in the rotation of breeds involved. Success with crossbreeding depends on the superiority of the parent stock regardless of breed.

Several systematic crossing programs can be used successfully. These include a single cross between two breeds, continuous two-breed cross and rotational cross of three or more breeds. Generally, a three-breed cross is recommended over other crosses if superior boars of three breeds are available.

**Single Cross Between Two Breeds**

A single cross is made by crossing two breeds. For example, Duroc sows mated to Hampshire boars or Yorkshire sows mated to Poland China boars. When replacement females are needed, purebreds are either produced by the sows in the herd or are purchased from another breeder.

Pigs produced from the single cross exhibit hybrid vigor, but this system does not take advantage of hybrid vigor on sow productivity from crossbred sows. You may partially overcome this by selecting sows for good mothering and milking ability.

This system is not generally recommended for the commercial producer because it requires the purchasing of purebred gilts. In the long run, if you select female replacements from your own herd, genetic improvement will be made with less risk of introducing disease problems.

**Two-Breed Cross**

The two-breed cross uses purebred boars of two different breeds in alternate generations (Fig. 2). Crossbred gilts are selected each

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**Figure 1. Three types of pork carcasses from 200-pound hogs shown with the cross-section of untrimmed loins and hams. From left: Meat Type—60.4 pounds ham and loin, loin eye area 0.28 square inches, fat trim 13 pounds. Meat-Less Type—50.6 pounds ham and loin, loin eye area 2.23 square inches, fat trim 13 pounds. Fat Type—49.8 pounds ham and loin, loin eye area 3.44 square inches, fat trim 22 pounds.**

**Table 1. Heritability Estimates.**

<table>
<thead>
<tr>
<th>Level of heritability</th>
<th>Trait</th>
<th>Average percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Carcass Length</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Percent Ham (based on carcass weight)</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Backfat Thickness</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Loin Eye Size</td>
<td>50</td>
</tr>
<tr>
<td>Medium</td>
<td>Percent Lean Cuts (based on carcass weight)</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Feed Efficiency</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Growth Rate (weaning to market)</td>
<td>30</td>
</tr>
<tr>
<td>Low</td>
<td>Weaning Weight</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Number farrowed</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Number weaned</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Birth weight</td>
<td>5</td>
</tr>
</tbody>
</table>
Crossbred sows

generation or year and mated to
one of the parent breeds. The boar
should be selected from the breed
having least relationship to cross­
bred females.

Under this system, both sows and
gilts are crossbred after first
crossing, and will yield more hybrid
vigor in sow production traits than
the single cross. Hybrid vigor
should result in increased litter
size, livability and growth rate.

Three-Breed Cross

The three-breed cross is the most
widely used and recommended sys­
tem for crossing. This system has
the advantage over two-breeds in
slightly increased vigor for certain
performance traits (Table 2). How­
ever, it is easier sometimes to find
top performing boars of two breeds
than three.

This system uses three different
breeds of boars in rotation on cross­
bred gilts and sows produced in the
program (Fig. 3). It is a continuous
rotation of boars from three breeds.
Gilts and sows each generation are
mated to boars of the breed that is
least represented in the females. A
three-breed cross using superior
performing boars on performance
selected females is the generally rec­
nommended program for most pork
producers.

A three-breed cross may be ex­
panded to four or more breeds; how­
ever, no added hybrid vigor
should be expected over a three­
breed cross. The primary disad­vantage of more than three breeds
is the difficulty in finding superior
performing boars in four or more
breeds.

Specific Three-Breed Cross

Some commercial companies
offer a crossbred female, usually a
cross of two breeds, and a boar of
a third breed for sale. This pro­
gram allows you to obtain hybrid
vigor in the sow and pig in the first
cross. The system permits the
breeder to select replacement ani­
mals on the basis of their specific
crossing ability. The producer may
wish to continue his crossing pro­
gram by selecting replacement gilts
from his stock or by returning to
the company for a new group of
gilts and boars after the original
sows fail to maintain high repro­
ductive efficiency.

Contrary to the general opinion,
crossbreeding programs do not lose
their hybrid vigor. If superior par­
ents are selected and a systematic
crossbreed program followed, the
program can run continuously.

Table 2. Performance Traits.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Percent increase over purebred</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two-breed cross</td>
</tr>
<tr>
<td>Litter Size</td>
<td>0</td>
</tr>
<tr>
<td>Number Weaned</td>
<td>19</td>
</tr>
<tr>
<td>Weaning Weight</td>
<td>19</td>
</tr>
<tr>
<td>Pig</td>
<td>7</td>
</tr>
<tr>
<td>Litter</td>
<td>28</td>
</tr>
<tr>
<td>Post Weaning</td>
<td>14</td>
</tr>
<tr>
<td>154 day weight</td>
<td>14</td>
</tr>
<tr>
<td>Feed Efficiency</td>
<td>negligible</td>
</tr>
<tr>
<td>Meatiness</td>
<td>0</td>
</tr>
</tbody>
</table>

Breed Selection

Selection of breeds to be used in
the crossing program is important.
Breeds should be selected to com­
plement each other in addition to
using breeds available locally.

Normally, when starting a pro­
gram, females should be selected
from a rapid, efficient gaining
breed with superior carcass merit.
When available, superior crossbred
females may be used and mated
with a boar of a different breed.
This procedure allows you to ob­
tain the hybrid vigor in the pig
and from the sow in the first gen­
eration.

To help you select breeds, the
breeds have been divided into three
groups based on their performance.
The basis for the division is avail­
able performance data.

1. Breeds rated high on mother­
ing and milking ability: Yorkshire,
Landrace, Chester White.

2. Breeds rated high on carcass
traits; Hampshire, Poland.

3. Breeds rated high on growthi­
ness; Duroc, Spotted Swine.

In selecting breeds for a three­
breed cross, one breed should be
selected from each group if supe­
or performing boars of those
breeds are available. When two
breeds are used, you have the choice
of selecting a breed from two of the
three groups. It would not be gen­
erally recommended to select all
breeds from one group.

How About Hybrid Boars

Several commercial companies
offer "hybrid" breeding stock for
sale. Most of these companies have
specific breeding plans to follow. If
you plan to use hybrid breeding
stock, follow the specific recom­
mendations of the company. Don't
Figure 3. Examples of how purebred boars are used on crossbred sows in three-breed rotation.

Figure 4. Carcass length and backfat thickness measurements. Length is measured from the lower point of the aitch bone to the forward edge of the first rib. Backfat is measured opposite the first rib, last rib, and last lumbar vertebra. The average of the three backfat measurements is used.

jump back and forth from hybrid to purebred boars and expect to get good results. Keeping records on performance and carcass lean-ness and quality will be your best guide for determining the value of your program.

Selection of Breeding Stock

The key to selection of superior breeding stock is your record of performance and carcass lean-ness. These records enable you to make more accurate decisions on the selection and purchase of breeding stock. Records should measure those traits which are of economic value to the pork industry—sow productivity, rate of gain, feed efficiency and meatiness. Carcass length, backfat thickness, percent ham and loin, and loin eye area are four of the criteria used to determine carcass value (Figs. 4, 5, 6, 7).

Purchasing Boars

Many programs are available to the purebred breeder to aid him in obtaining information. Breed certification, on the farm testing, test stations and ultrasonic measurements are now used by many breeders. These programs provide information for you to determine which boar you should select (Table 3).

Records identify the genetic potential of the boar. It gives you a good idea of what he can or cannot do for you. Buying and selecting your boar each year is probably the
La y a ruler straight edge from a point on the left scale which represents the age of pig when weighed, to a point on the right scale which represents actual weight of pig. The intersection of the line on the center scale shows the estimated weight in pounds at 154 days of age.

### Figure 8. Chart for estimating weight at 154 days of age.

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<table>
<thead>
<tr>
<th>Litter Size</th>
<th>Growth Rate</th>
<th>Feed Efficiency</th>
<th>Probed backfat at 200 lbs.</th>
<th>Nipples</th>
<th>Feet and Legs</th>
<th>Carcass cut-out of relatives</th>
<th>a. Ham and loin (percent of carcass wt.)</th>
<th>b. Backfat</th>
<th>c. Length</th>
<th>d. Loin Eye area</th>
<th>Ultrasonic Reading of Loin Eye area on individual boar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 raised</td>
<td></td>
<td></td>
<td></td>
<td>175 lbs. and above at 5 months</td>
<td>14 lbs. or less; preferably under 1.2 inches</td>
<td>12 or more evenly spaced, functioned nipples</td>
<td>4.0 square inches or more</td>
<td>4.75 or more square inches between 190 and 230 pounds</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200 to 225 pounds at 5 months</td>
<td></td>
<td></td>
<td></td>
<td>Less than 325 pounds</td>
<td>1.4 inches or less</td>
<td>sound with good bone</td>
<td>Same as boar</td>
<td>between 190 and 230 pounds</td>
</tr>
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<td></td>
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</table>

Table 3. Suggested Minimum Standards for Selection of Boars.

<table>
<thead>
<tr>
<th>Litter Size</th>
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</tbody>
</table>

Table 4. Suggested Standards for Selecting Replacement Gilts.

Selecting Gilts

Making the correct decision on gilt replacement is one of your necessary jobs to receive full benefit from your breeding program. You must select the fast gaining meaty gilts and cull the slow gaining fatter gilts. The following program is suggested. For more information, contact your county Extension office or write to Animal Science Extension, University of Nebraska, Lincoln, Nebraska.

At Farrowing Time

1. Identify pigs at birth by ear notches.
2. Record litter birth date.
3. At 175 to 225 Pounds
   1. Make initial selection on gilts from herd on basis of size and soundness. Select at least 50% more than needed.
   2. Weigh gilts accurately and correct to constant age (Fig. 8).
   3. Probe gilts for backfat and correct to 200 lbs. (Fig. 9.) Your county agent will help you probe your hogs.
   4. Select gilts with low backfat and high gain with visual evidence of meatiness (Table 4).

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Figure 9. Backfat probe adjustment chart, 200 pounds live weight. Lay a ruler or straightedge from a point on the left scale which represents the weight of the pig when probed, to a point on the right scale which represents the total of the three probes. The intersection of this line and the center scale shows the estimated average backfat thickness at 200 pounds.