# RECENT RESEARCH FINDINGS IN PIG BREEDING

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In Germany, until 1985, there was a more or less subjective carcass classification system in use which was mainly based on conformation of the ham. In 1985 this system changed into a carcass classification system based only on objective fat and muscle measurements using different instruments such as the Hennesy Grading Probe or the Fat-0-Meter (FOM). For each instrument one formula is used to estimate the lean meat yield in the carcass. The pricing system is based on this estimated lean meat content. Currently the following pricing system is used:

- base price per kg slaughter weight at 54 % lean meat
- a bonus of .05 DM / % / kg from 54 to 60 % lean meat
- a reduction of .06 DM / % / kg from 54 to 50 % lean meat
- a reduction of .08 DM / % / kg from 50 to 40 % lean meat
- slaughter weight limits from 80 to 105 kg
- a reduction of .02 DM / kg for weight less than 80 kg
- a reduction of .03 DM / kg for weight less than 70 kg
- a reduction of .02 DM / kg for weight more than 105 kg

Besides this classification and pricing system the organization of meat quality programs has influenced the development of breed structure in German pig production as shown in Figure 1. At present around 15 to 20 different meat quality programs are organized which pay between 10 to 20 DM/carcass above the normal market price. The definition of these meat quality programs is based on certain limits in meat quality traits, slaughter weight, and lean meat content. Additionally there are requirements in feeding and even in housing and breeds to be used.

## 1. NEW RESULTS FOR GROWTH AND CARCASS TRAITS

At present the main question for breeding companies, and other breeding organizations, is the choice of the best possible terminal sire to produce the desired slaughter pig. In nearly all three breed crosses, and within the important breeding companies, an Fl-gilt containing 50% German Landrace (DL) and 50% Large White (LW) is used in weaner production. In table 1 the results for growth and carcass traits for different terminal sire groups, all mated to a LW*DL Fl-gilt, are shown. The terminal sire Pi*Ha is used as a reference group because this is the most common terminal sire at present. Within each group a total of 140 pigs were slaughtered.

**FIGURE 1: Development of Breed Structure in Weaner Production Farms in West Germany**

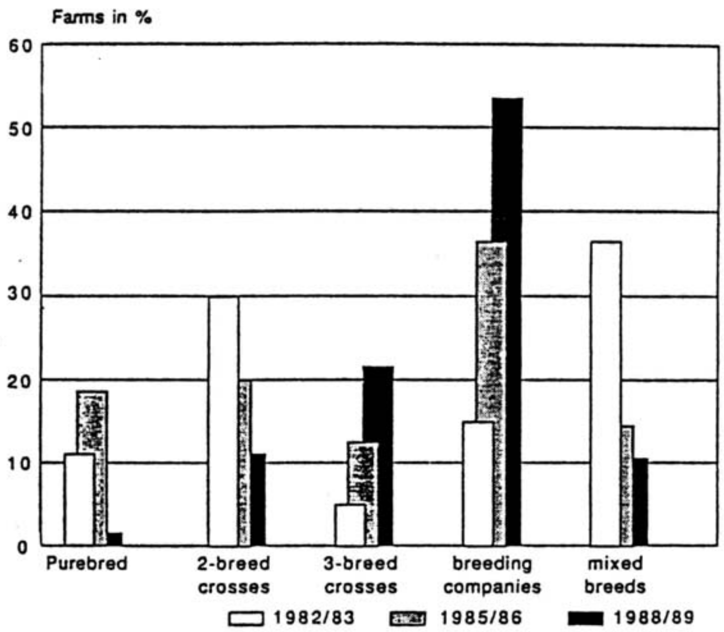



**TABLE 1: Growth and Carcass Traits for Different Terminal Sire Breeds, Mated to Fl-gilts (LW * DL), Expressed as Deviation from the Pi*Ha Terminal Sire Group. (Surmann 1991)**

| Sire breed | | | Daily gain | Meat Percentage | Backfat | | Muscle depth |
|---|---|---|---|---|---|---|---|
| | | | | | P1 | P2 | |
| Pi | * | Ha | 705 | 53.7 | 16.9 | 20.3 | 57.7 |
| | Ha | | -44 | +0.6 | -0.3 | -1.0 | +0.8 |
| | Pi | | -37 | +0.6 | -0.5 | -0.7 | +0.8 |
| Y | * | Pi | +9 | -0.3 | -0.3 | -0.6 | -2.4 |
| Ha | * | Du | -2 | -2.2 | +1.4 | +1.9 | -3.9 |
| Pi | * | (Pi*Ha) | -20 | +1.7 | -1.9 | -2.3 | ±0.0 |
| Pi | * | Du | +6 | -0.5 | +0.4 | +0.7 | -0.1 |

Pi = Pietrain; Ha = Hampshire; Y = Yorkshire; Du = Duroc

The terminal sire group Pi*Ha shows significantly higher daily gain than the pure Pietrain or Hampshire sires. Also the sire group with 75 % Pietrain (Pi*(Pi*Ha)) has a nearly 20 g lower daily gain than the standard group. The differences between Pi*Ha group and the remaining sire groups are not significant. In lean meat percentage, however, the Pi*(Pi*Ha) group leads at 1.7 % above the standard group. The Ha*Du sire group shows the lowest lean meat percentage, with 2.2 % less than the Pi*Ha group. Differences in lean meat yield can be explained by comparing backfat and muscle measurements for each of the sire groups. The higher lean meat percentage in the Pi*(Pi*Ha) group is due mainly to the lower backfat measurements, whereas the low value for lean meat percentage in the Ha*Du group can be explained by higher backfat thickness and lower muscle depth than the standard sire group.

The results of growth and carcass traits of the most important breed groups and breeding companies are shown in table 2. These results are based on a sample of 160 to 180 pigs within each group all fattened at one farm with the same feeding and housing system.

**TABLE 2: Growth and Carcass Traits for Different Breed Groups and Breeding Companies (Meier 1991)**

| Breed | Net gain | Meat Percentage | Backfat | | Muscle depth |
|---|---|---|---|---|---|
| | | | P1 | P2 | |
| Pi * DL | 483 | 53.8 | 18.6 | 20.3 | 61.6 |
| Pi * (LW*DL) | 487 | 53.7 | 18.3 | 20.7 | 60.5 |
| (Pi*HA) * (LW*DL) | 497 | 53.3 | 18.4 | 19.9 | 59.1 |
| BHZP[1] | 523 | 53.5 | 17.8 | 20.3 | 58.9 |
| PIC[1] | 503 | 52.8 | 18.1 | 20.4 | 56.5 |
| NEW DALLAND[1] | 501 | 53.0 | 17.9 | 19.2 | 55.4 |

[1] Animals in these groups were final cross of each companies program.

The differences between the groups shown in table 2 are smaller in all traits than in table 1. The pigs of breeding companies show a significantly or slightly higher net gain, whereas the other groups are leading in lean meat yield. It can be seen that, although there is no difference in meat percentage between Pi*DL and BHZP, these groups are significantly different in P1 and in muscle depth. The low result in meat percentage for the PIC group can be explained by the lack in muscle depth with average fat measurements. The above results indicate that improvement in lean meat percentage does not necessarily mean improvement in all the component traits that determine lean meat percentage.

## 2. NEW RESULTS FOR MEAT QUALITY

In the area of meat quality, current research in Germany and discussions with industry deal with meat quality traits after halothane stabilization. The desired pig to slaughter should be halothane negative, but most of the terminal crosses are carriers of the halothane gene due to the use of the Pietrain breed as a terminal sire. Within the Pietrain breed it is assumed that about 90 to 95 % of the animals are halothane positive.

Another area of interest in meat quality is the problem of the so called 'ACID MEAT' condition. Monin and Sellier (1985) in France first described the condition in Hampshire breeds. This meat quality type is as undesirable as PSE (pale, soft, exudative) and DFD (dark, firm, dry). In Figure 2 the relationship between ACID MEAT, PSE and DFD to pH-values after slaughter is shown. Pigs of the ACID MEAT type show very low ultimate pH-values in connection with higher water losses (drip and cooking losses) and lower protein content, but have very good early post mortem meat quality. A single dominant gene is assumed to be responsible for the ACID MEAT type, with a very high frequency within the Hampshire breed.

**FIGURE 2: Meat Quality Types in Pigs Looking at pH Values after Slaughter**

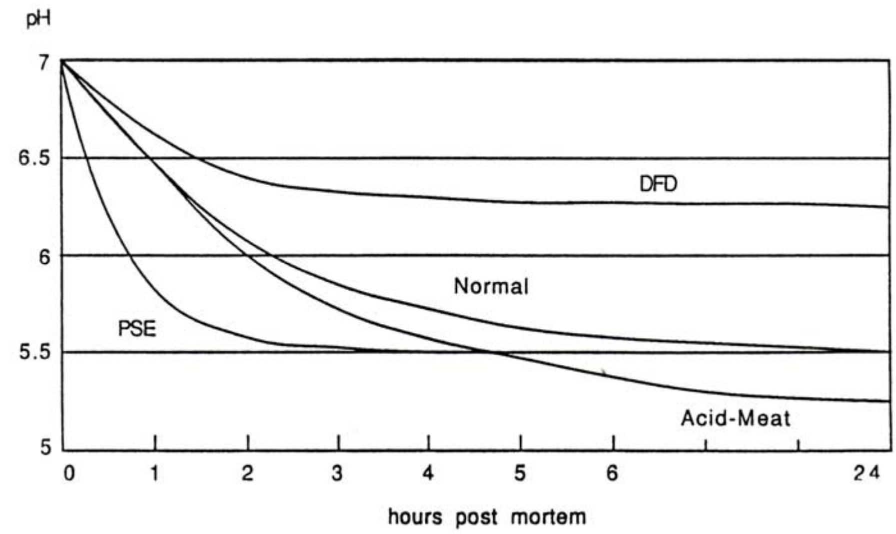


Table 3 presents meat quality types for progeny from different terminal sires groups, mated to Fl-gilts (LW^DL). The last column shows the percentage of all slaughtered pigs which are within the defined criteria of a meat quality program and obtaining higher carcass prices. The amount of PSE-meat is closely connected to the percentage of Pietrain within the final cross (see also Figure 2), whereas the ACID MEAT type seems to be dependent on the percentage of Hampshire within the final cross (see also Figure 5). The low values for the Duroc crosses in the last column are primarily a result of lower meat percentage (see table 1) and not because of meat quality problems.

**TABLE 3: Meat Quality for Different Terminal Sire Breeds Mated to F1-Gilts (LW * DL), Expressed as % of Progeny in Each Category (*Surman*n 1991)**

| Sire Breed | % showing PSE | % showing DFD | % showing Add Meat | % in meat program |
|---|---|---|---|---|
| Pi * Ha | 6.5 | 2.7 | 5.8 | 52.5 |
| Ha | 2.5 | 0.0 | 18.8 | 54.7 |
| Pi | 16.2 | 4.0 | 8.0 | 51.2 |
| Y * Pi | 6.3 | 12.5 | 0.0 | 50.0 |
| Ha * Du | 0.0 | 3.4 | 0.9 | 32.2 |
| Pi * (Pi*Ha) | 10.0 | 5.2 | 6.8 | 59.0 |
| Pi * Du | 2.8 | 8.5 | 0.0 | 38.7 |

PSE = pH 45 minutes post mortem ≤ 5.8

DFD = pH 24 hours post mortem ≥. 6.0

Add meat = pH 24 hours post mortem ≤ 5.4

Defined limits for meat quality program:

pH 45 minutes > 6.0, slaughter weight > 82 kg, meat percentage > 52 %

The results for some meat quality traits within different final crosses are shown in Figures 3 to 6. In Figures 3 and 4 the results of the terminal sire groups (Table 1 and 3) are shown. Figure 5 shows the results of different final Hampshire crosses. In Figure 6 the results of different Hampshire crosses are summarized.

The results in Figures 4 and 5 agree with findings from the French research group (Monin and Sellier, 1985). The Hampshire pigs show lower protein content and higher total water losses. A segregation analysis has shown that a single gene is responsible for these differences. In Figure 6 the results of different Hampshire groups slaughtered subject to different stress treatment prior to slaughter are shown. The condition in the Wassmuth study can be explained as very soft preslaughter treatment. In the Surmann experiment the pigs are slaughtered under normal conditions of a modern abattoir, whereas the pigs from the test stations had to suffer the hardest conditions prior to slaughter. Under all conditions the pure Hampshire, or crosses with Hampshire, show the lowest pH-value 24 hours post mortem, but differences relative to other groups increase with more stressful treatment before slaughter (Wassmuth - Surmann - Station Test). In conclusion Figure 6 shows that frequency of ACID MEAT type pigs is influenced by the treatment before slaughter. It is well known that this conclusion also holds for the other undesired meat quality types PSE and DFD.

**FIGURE 3: LSQ-Means for pH 45 Minutes Post Mortem of Longissimus Dorsi and Semunembranosus (Surmann)**

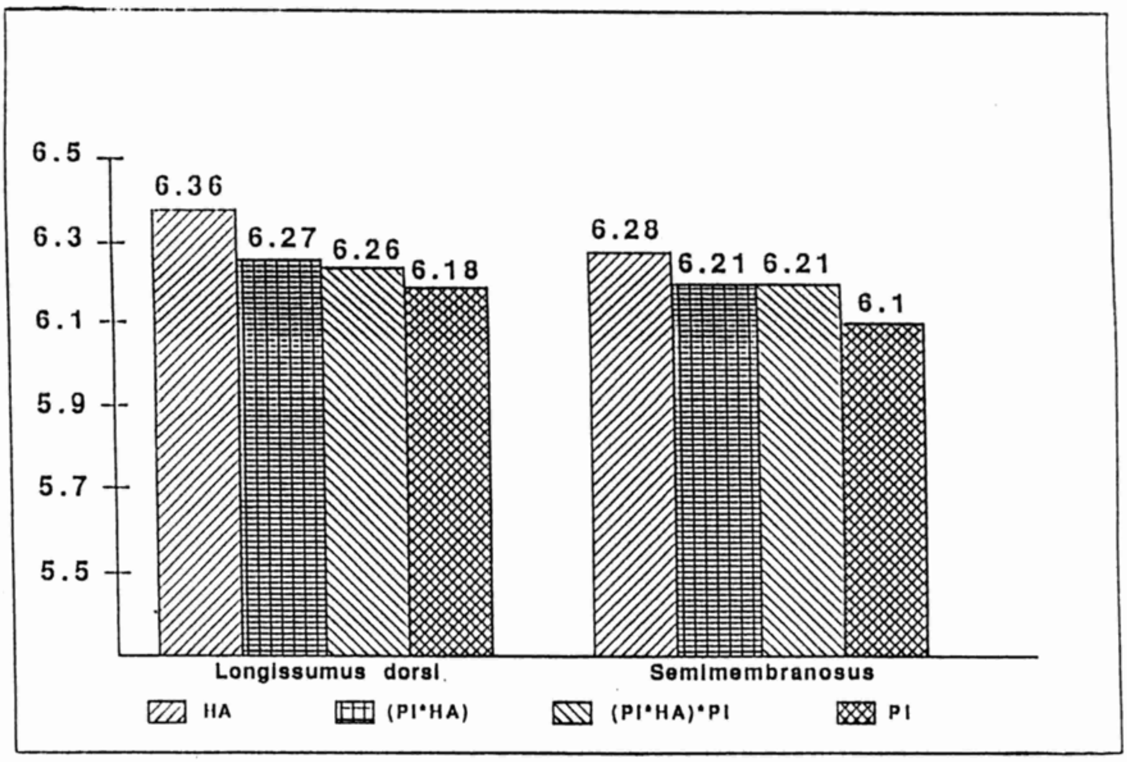


FIGURE 4: LSQ-Means for Protein Content of Longissimus dorsi *(Wassmuth)*

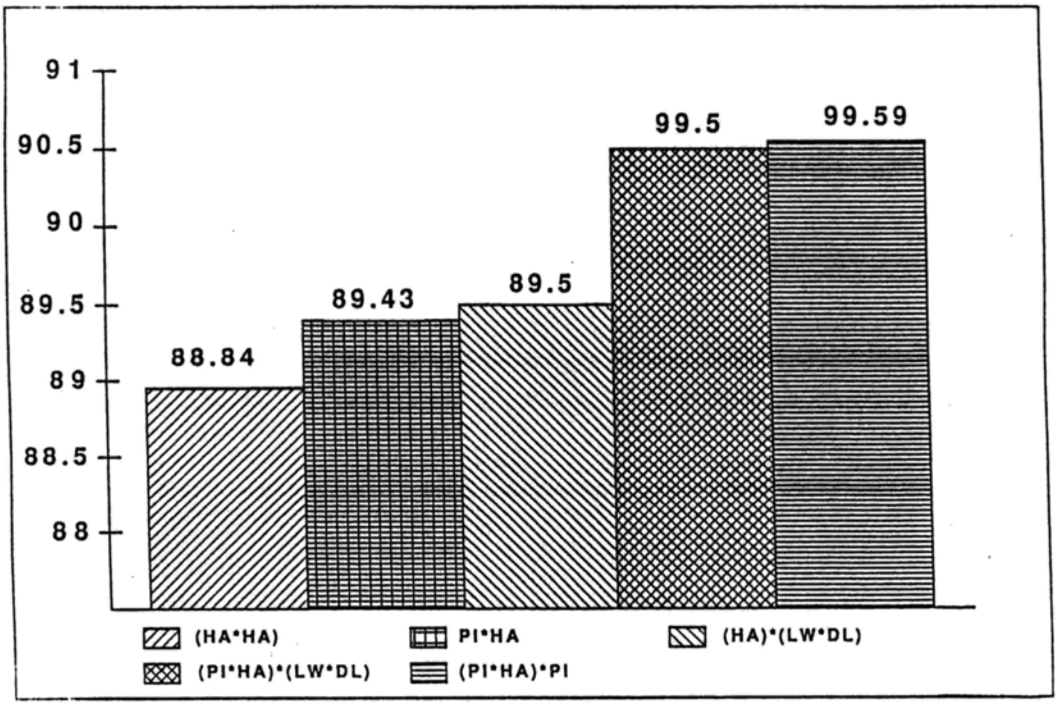



FIGURE 5: LSQ-Means for Total Water Losses (Drip and Cooking Losses) *(Surmann)*

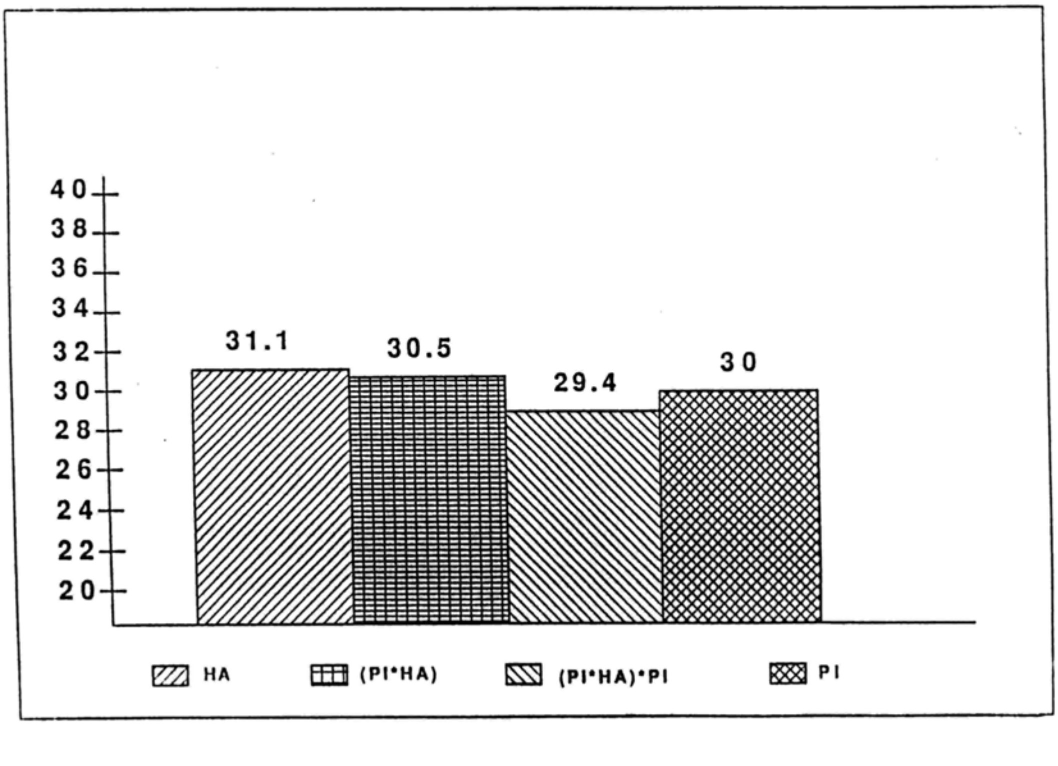
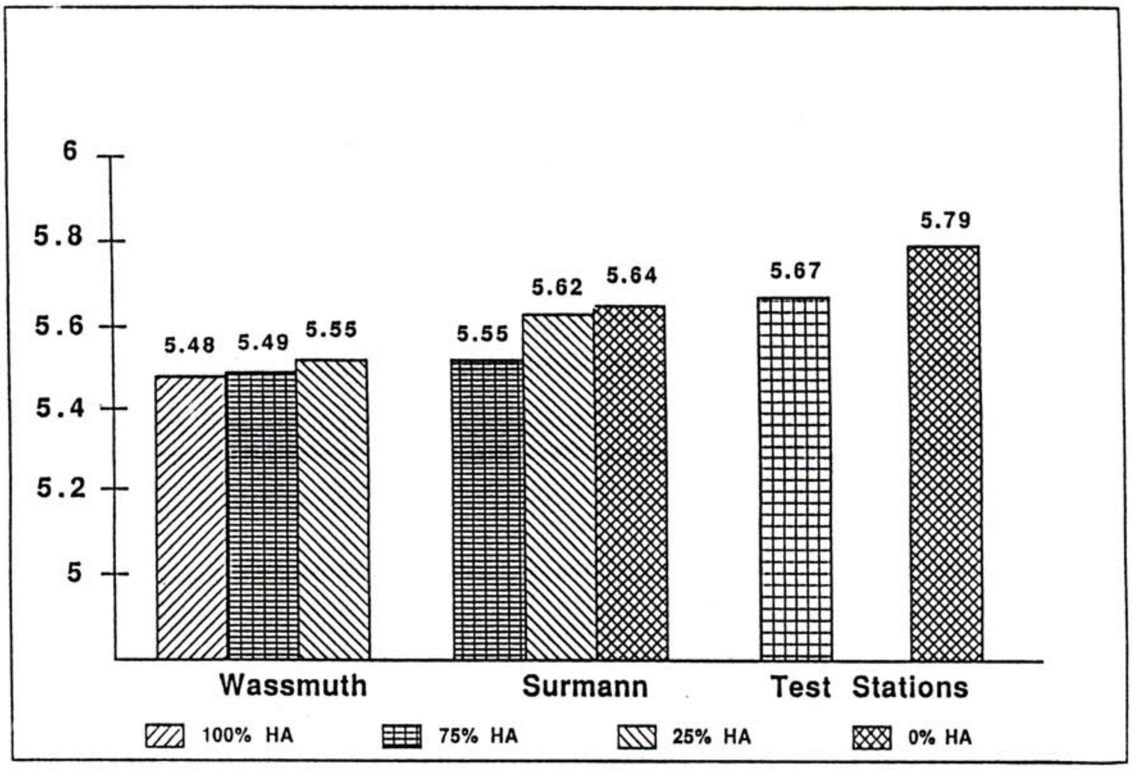


**FIGURE 6: Means for pH 24 Hours Post Mortem in Different Hampshire Crosses**




## 3. PUREBRED *VERSUS* CROSSBRED PERFORMANCE IN SELECTION

Within breeding companies and organizations selection to achieve genetic progress is done within the purebred lines used to breed the final crosses. Selection is based on an individual's own performance test and information from parents and full- or half-sibs, using purebred information only. It is assumed that the genetic progress within the purebred lines accumulates in the final three or four breed cross. Very few published results adequately answer the question of whether there is an interaction between purebred and crossbred performance. The ranking of Pietrain boars for meat percentage and backfat thickness based on different station tested progeny groups are shown in Figures 7 and 8. A total of seven Pietrain boars were mated to 4 sows of each group, (Pi, Ha, DL and LW*DL), and 2 full-sibs out of each mating were sent to station test, with a total of 8 progeny within each breed group tested.

**FIGURE 7: Ranking of Pietrain-Sires for Meat Percentage Based on Different Station Tested Progeny Groups (*Meier* 1990)**

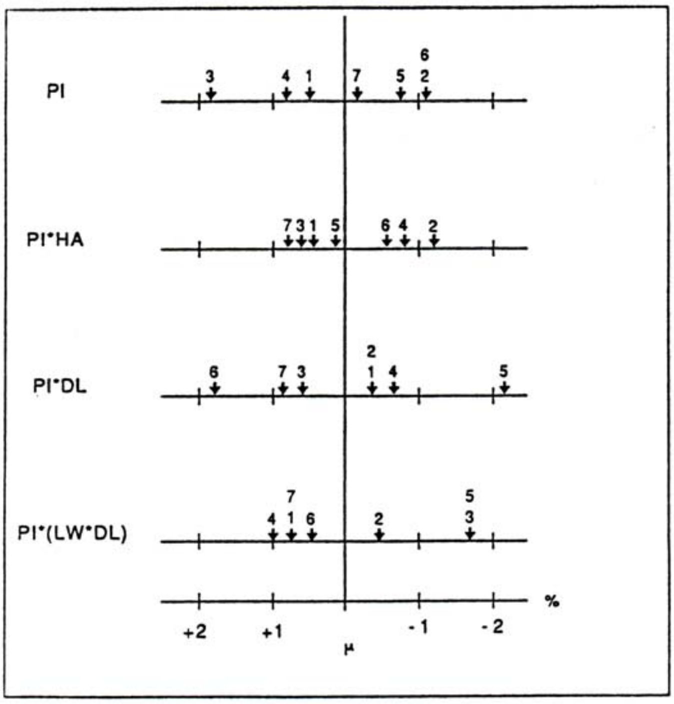
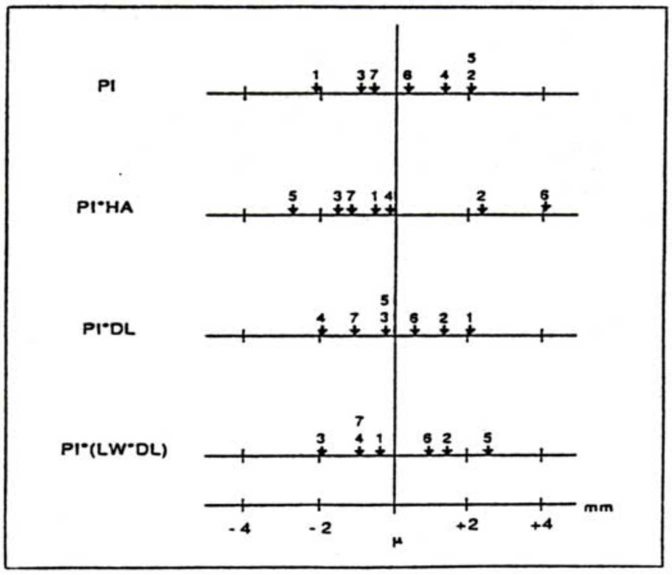



Figure 7 indicates that boar number 3 would be the top ranking boar for meat percentage within the purebred progeny, but would be ranked last for the group were he is used in commercial production. Boar number 6 shows almost the opposite results, with boar number 2 showing some consistency within its ranking in all groups. Similar results concerning backfat thickness can be found in figure 8. Boar number 1 for example is best within the purebreds, last within the single cross PI*DL and average within the other groups.

The results shown here are based only on a small number of boars and few progeny within each group. It appears, however, that further research with larger samples of boars and progeny groups would be valuable in identifying interaction between purebred and crossbred performance. By means of electronic identification and recording systems larger data sets will be available in the future. If all the breed group types (purebred, single crosses and the final crosses) used in the production system are available for an appropriate genetic evaluation, a complete animal model (BLUP) could handle this situation.

**FIGURE 8: Ranking of Pietrain-Sires for Backfat Thickness Based on Different Station Tested Progeny Groups**




## 4. GENE TECHNOLOGY IN PIGS

Genetic mapping of mammalian genomes has advanced rapidly by using recently developed molecular biological techniques. Compared with other species, relatively few genes have been mapped in pigs, and only a few loci have been identified as related to production traits, more or less by accident rather than intentional research. In Europe, a group involving several laboratories and countries is coordinating gene mapping effort for pigs. Other laboratories elsewhere, e.g. Australia and the United States, are working in the same area. There is still some basic work required before more potential genetic markers are identified. Specialists in this area, like Dr. Brehm from Munich, assume there are more potential genetic markers in the area of diseases and disease resistance than for production traits such as growth, lean meat production or litter size.

## 5. CONCLUSIONS

The pig market in Germany, and other European countries, is still demanding a lean meat carcass but with a defined meat quality in terms of PSE, DFD and ACID MEAT conditions. New research areas in meat quality involve traits which are highly related to tenderness and juiciness of meat, such as intramuscular fat and fat quality. In Switzerland a first approach has been made to include fat quality in the pricing system for pigs.

Developments in pig breeding in Europe have shown that the only way to fulfil market demands, and to produce pigs with high growth rate and good reproduction performance, is to utilise three or four breed terminal crosses. Synthetic lines are not competitive under European market conditions.

In the area of estimating breeding values two new aspects need considering in the near future, viz.

(i) Pure and crossbred information must be included in evaluation systems if crossbred pigs are the final slaughter product.

(ii) With further development of gene mapping further marker assisted selection will become more important. The interplay between gene mapping and the advanced procedures currently used for the estimation of breeding values will need to be understood to determine the value of marker assisted selection.

# NOTES