MATE SELECTION FOR JOINT CONTROL OF RESPONSE AND INBREEDING IN CLOSED PIG BREEDING HERDS

By

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Acknowledgements

My last thesis was dedicated to my dog, Basil. This one is dedicated to my family. May they have the sense never to read it!

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Abstract

Simple mate selection procedures for the joint control of response to selection and inbreeding were evaluated in a dynamic pig breeding population using stochastic simulation. The simulated populations modelled a closed breeding herd of moderate size (approx. 270 sows), characterised by overlapping generations and continuous cycles of performance testing and selection. Two studies were conducted: 1) where selection was for a single trait under three different heritabilities (ST), and; 2) where selection was for an aggregate genotype under three different breeding objectives (MT). Trait heritabilities for ST studies were 0.1, 0.35 and 0.6, and breeding objectives for MT studies defined general purpose (GP), terminal sire (TS) and maternal (MAT) selection lines.

Within each of these studies, comparisons were made between selection criteria and mating system. The selection criteria were:

ST:

- Individual performance (mass selection)
- Estimated breeding values (EBVs) calculated using Best Linear Unbiased Prediction (BLUP)

MT:

- Selection index values combining information on reproductive performance of the dam (number born alive: NBA), and individual records for average daily gain (ADG) and P2 backfat (BF).
- BLUP index values combining EBVs for NBA, ADG and BF.

Within each selection criterion, six non-random mating systems were compared with fully random mating (**R**):

A: Assortative mating with a positive correlation of mates' selection criterion values.

MS1: Mate selection with full emphasis on maximising predicted genetic merit in the progeny.

MS5: Mate selection with full emphasis on minimising inbreeding in the progeny.

MS2, MS3 and MS4: Mate selection combining information on additive merit with information on progeny inbreeding, with the aim of maximising joint merit. Increasing emphasis is placed on inbreeding information from **MS2→MS4**.

Results from ST and MT studies illustrated that both response to selection and inbreeding were increased relative to mass or index selection alternatives where an EBV was the selection criterion (random mating). Relative changes in response and inbreeding using BLUP EBV depended on trait characteristics. In ST studies, improvements in response under EBV selection ranged from 7% to 64% with decreasing heritability, accompanied by increases in inbreeding of 1.5- 4.3 times. Similarly, response in aggregate merit under BLUP index selection ranged from 16% to 19% according to breeding objective, and increases in inbreeding were up to 2.5 fold. In comparison to random mating, both response and inbreeding were further altered under non-random mating systems.

Improvements in response were possible with positive assortative mating, with both response and inbreeding under assortative mating affected by trait characteristics. In ST studies, assortative mating improved response by less than 5% under phenotypic selection but by up to 11% under EBV selection. Corresponding inbreeding was up to .34 times higher under mass selection, but up to 1.9 times higher under EBV selection. Superiority of **A** under selection or BLUP index was no more than 4%-8% in MT studies, although four fold increases in inbreeding were apparent.

In comparison, **MS1-MS4** generally resulted in improved levels of response compared to that resulting under assortative mating, although substantial differences in inbreeding were apparent. For example, inbreeding differed between **MS1** and **MS4**

by up to 2.4 times according to heritability (ST studies) or breeding objective (MT studies). Relative to assortative mating, final levels of genetic variation were higher under mate selection options as the result of lower inbreeding. Thus, substantial improvements in the balance between response and inbreeding were made under mate selection.

Overall, non-random mating systems were most effective for improving response where accuracy of selection was high, and where single trait selection was practised. As with the influence of selection criterion, the impact of alternative mating systems on response and inbreeding was dependent on trait characteristics. In addition, the relative emphasis which should be placed on inbreeding information under the mate selection approach outlined was identified as an area requiring further study.

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