**TOOLS OF THE TRADE – Cross Breeding**

Planned and well managed crossbreeding systems will deliver significant benefits to beef producers. The main benefits result from:

1) Higher performance than expected for a range of traits through hybrid vigour (also known as heterosis).

2) Combining the benefits of breeds known as breed complementarity.

Let’s look at both benefits in more detail.

**Hybrid Vigour** - Hybrid vigour is the amount by which crossbred animals exceed (or differ from) the average of the purebred parents used in the cross (figure 1).

![Figure 1 – Example of Heterosis for weaning weight.](image)

A crossbreeding trial undertaken by the Queensland Department of Primary Industries (QDPI now known as DEEDI) highlighted the benefits achieved through a structured crossbreeding program for weaning weight. This trial included crosses of Hereford, Angus and Shorthorn cattle in Southern Queensland. Compared to the straight bred calves, the F1 crossbred calves showed an 8.5% increase on average in weaning weight per cow mated. While significant, a larger increase of 23.3% was observed in the F2 calves, being calves bred from F1 cows obtaining the additional “boost” from maternal heterosis (Figure 1).
The previous trial shows the benefit of hybrid vigour to weaning weight per cow mated however it will also be expressed in many economically important beef cattle production traits, especially in traits of “low” heritability such as reproduction and adaptability traits. Table 1 illustrates the relationship between heritability and heterosis regarding different categories of beef cattle traits. Reproduction and maternal traits have low heritability and response to selection will generally be slower compared to high heritability traits. At the same time, significant improvement in these traits can be made through programs that maximize heterosis.

Table 1: Heritability and Heterosis comparison

<table>
<thead>
<tr>
<th>Traits</th>
<th>Heritability</th>
<th>Heterosis</th>
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<tr>
<td>Fertility, Mothering ability, Calf Survival</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Birth &amp; Weaning weight, milk</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Carcase</td>
<td>High</td>
<td>Low</td>
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</tbody>
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The inverse is true with carcase traits. Significant and rapid progress can be made through selection for carcase traits, while crossbreeding has little or no effect. Growth traits are moderate for both heritability and heterosis, making progress possible through selection and crossbreeding.

The amount of hybrid vigour achieved will depend on the type of crossbreeding or composite system implemented. A composite breeding program is a crossbreeding system that is stabilised (inter-mating the crossbreds). The following table lists the types of crossbreeding systems, the levels hybrid vigour (both individual and maternal) retained and estimates of increases in weaning weight per cow mated (Table 2).

Table 2. Crossbreeding Systems and Estimated Levels of Hybrid Vigour.

<table>
<thead>
<tr>
<th>System</th>
<th>Individual (%)</th>
<th>Maternal (%)</th>
<th>% WT calf/cow</th>
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<tr>
<td>2 breed cross</td>
<td>100</td>
<td>0</td>
<td>8.5</td>
</tr>
</tbody>
</table>
To re-iterate, to fully benefit from Hybrid Vigour the cowherd should also be crossbred. Crossbred cows when compared to purebred females will generally have have:

- increased conception rates
- improvement in calving ease
- increase in percentage of calves weaned
- A longer production life (i.e. longevity)

**Breed Complementarity** results when combining the strong traits of one or more breeds to compensate for the weak traits of another breed. For example Red Angus and Simmentals complement each other exceptionally well. In general terms, Red Angus contributes the poll gene, early maturity, easy finishing and calving ease while Simmentals contribute high growth and muscle.

A simple cross breeding system could utilise Red Angus and Simmental genetics. This requires two joining mobs. The daughters of the Red Angus are joined to the Simmental sire and vice versa (known as a criss-cross mating system). This system is relatively easy to manage and generates its own replacement females including maternal hybrid vigour. The progeny will stabilise at 66% Red Angus, 33% Simmental and vice versa. These breeds work in this system as they both have maternal qualities, and are complementary in carcase and maturity patterns. Using a Red Angus with Simmental also eliminates grey calves that can be produced when crossing Black Angus and Simmental.

**Crossbreeding Considerations** - There some considerations that need to be taken into account regarding the implementation of a crossbreeding program. These include:

- Managing and/or sourcing replacement females depending on crossbreeding system implemented.
- Crossbreeding programs may require more joining groups than a purebred system. This could be eased by purchasing replacement heifers although locating a source of heifers available on a regular basis with suitable health status and known breeding may be difficult.
- Hybrid vigour may result in higher birth weights when sires of a high growth rate breed are joined to heifers of a smaller breed. Selection of genetics is essential to counteract this negative.
- Crossbred females may be larger and therefore consume more feed than purebred females. Research has indicated that productivity per hectare still favours the crossbred female.

**Selection & Crossbreeding** - Crossbreeding should not be seen as an excuse for using “low” performing genetics (i.e bulls). Regardless of hybrid vigour, the performance of the crossbred herd will depend largely on the performance of the parent, the management level and the environment that is used. Figure 3 illustrates the benefits of combining selection with crossbreeding.
Following are several tools that should be utilised in your selection tool kit to ensure the “best” genetics are used in the crossbreeding program.

**BREEDPLAN EBVS** - BREEDPLAN is a modern genetic evaluation system for beef cattle breeders offering the potential to accelerate genetic progress in their herds, and to provide objective information on stock they sell to commercial breeders. BREEDPLAN uses the world’s most advanced genetic evaluation system (based on Best Linear Unbiased Prediction (BLUP) technology) to produce Estimated Breeding Values (EBVs) of recorded cattle for a range of important production traits (eg. weight, carcase, fertility). Included in the calculation of EBVs are the animal’s own performance, the performance of known relatives, the heritability of each trait and the relationship between the different traits.

**BREEDOBJECT Selection Indexes** enable cattle producers to make “balanced” selection decisions, taking into account the relevant growth, carcase & fertility attributes of each animal to identify the animal that is most profitable for their particular commercial enterprise. Selection Indexes reflect both the short term profit generated by a sire through the sale of his progeny, and the longer term profit generated by his daughters in a self replacing cow herd. Red Angus has selection Indexes available for the Vealer, Supermarket and Export production systems.

*(Detailed information on these tools can be found at [http://sbls.une.edu.au/](http://sbls.une.edu.au/))*

Further information on crossbreeding can be obtained from Christian Duff, Red Angus SBTS Technical Officer (02 6773 2472 or christian@sbls.une.edu.au)

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*Article compiled by Christian Duff for inclusion in Red Angus Annual 2011*

References: G Simm, Red Angus Association of America, MLA, Southern Beef Technology Services. BREEDPLAN.