INFO SHEET

Achieving the Optimal Results from Parent Stock Selection

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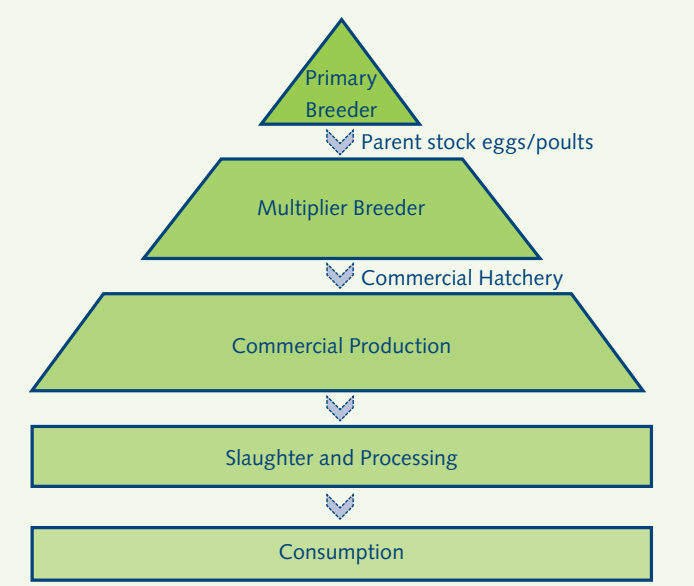
Introduction

Genetics are passed down through the turkey industry and have been described as similar to a pyramid, with the primary breeder sitting at the apex (see Figure 1). The primary breeders, such as Hybrid, supply parent stock to multipliers, who in turn supply poults for commercial production. Once the superior genetics contained within the parent-stock are supplied to the multiplier, the primary breeder can no longer improve their genetic potential, though the genetic potential can still be improved with parent stock selection. Past Info Sheets have documented the advantages of male line parent stock selection in terms of the resulting increase in progeny bodyweight. This Info Sheet will consider a number of additional factors in optimising male line selection and the apparent consequences of firstly: inadequate management, and secondly: suboptimal selection age. Lastly, it will also consider the optimal selection intensity, given that selection not only has an effect on commercial bodyweights, but it also has correlated effects on breast meat yield, mortality and feed conversion (FCR). Identifying the optimal selection pressure is a function of the costs required to raise additional parent stock (to achieve higher selection intensities), weighed against the expected returns from bodyweight and the other correlated traits due to selection. The returns generated depend on whether the multiplier is operating within an integrated company (as shown by the dark area in Figure 1), or operating independently supplying commercial poults. Both of these scenarios will be assessed to identify the optimum selection intensity.

Bodyweight selection of male line toms is an easy way to improve commercial performance, but there is cost associated with investment in additional parent stock and the requirement of additional space in which to rear selection candidates. As each can have a significant cost associated with it, one would want to optimise the results gained from the investment considering the returns in a cost-benefit analysis.

Figure 1. Pyramid structure and the flow of genetics in today's turkey industry



Optimal Male-Line Management Through to Selection

When considering selection on bodyweight, one normally assumes that the heritability (h2) of bodyweight is approximately 40-45%. This means that in the standard case, 40% of the ratio in the variation in bodyweight found in the progeny can be traced back to the sire and dam's genes.

P = G + E

In this equation the performance (P) (or phenotype) of the progeny is due to the birds inherited genetics (G) and also environment (E) in which it was raised. The environment is everything from growing conditions such as litter, space and air through to feed, water and barn management. This has also been described as 'being a product of nature or nurture'. In reality, it is almost always a mixture of the two. A further complicating factor is GxE or genotype-byenvironment interaction, but to simplify things it will be assumed that this does not have an effect in these examples.

Increasing the Environmental Variation

It is important to compare the quality of the genetic package of an individual tom against that of its flock mates. By increasing the influence that the environment has on the performance of a bird amongst its flock mates, it becomes more difficult to determine what is due purely to genetics, since the environment is having a proportionately greater effect on performance. If there were less of an environmental impact, the performance would be more evidently due to the genetics of the tom, and it could be judged whether a superior bird on bodyweight is indeed superior due to genetics, and not luck in a poor environment.

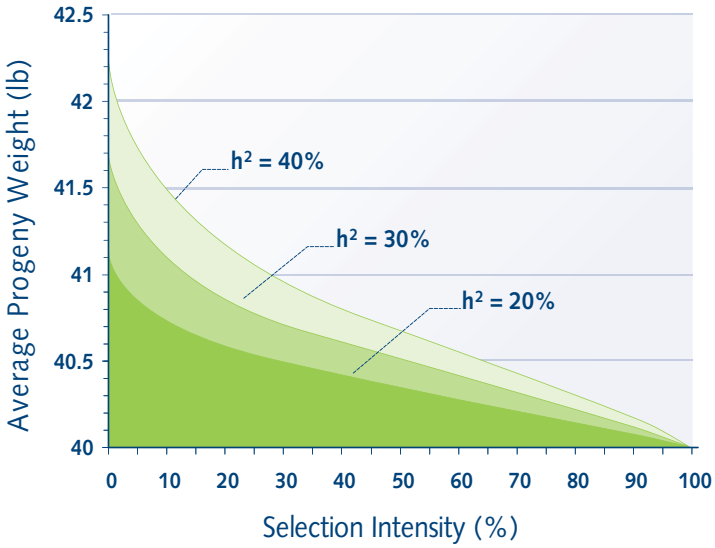
What is meant by increasing the impact of the environment, and its common causes:

- Severe feed restriction before selection.
- Health issues (particularly respiratory infections disease).
- Inadequate housing management, in particular air quality, air flow and housing density.
- Unevenness in brooding will result in unevenness in the adult.

Any management that increases the variation within a flock and that does not allow an individual to perform to its true genetic potential can decrease the response from parent stock selection. Increasing the environmental component effectively decreases the heritability (h2) that is used to select for bodyweight. By decreasing the heritability, selection response in bodyweight and the selection response in the correlated traits is also decreased.

Figure 2 demonstrates the decrease in selection response in progeny bodyweight that occurs when the heritability is decreased due to greater environmental variation. For example, at a given selection intensity of 30%, the difference between the two extreme values (h2 = 0.4 and 0.2) can be upwards of 0.5lbs or 225gms in the commercial progeny. With a decreased environmental effect (i.e. h2 = 0.3) this difference reduces but is still present to some degree, and therefore decreases the effectiveness of parent-stock selection. The extent to which sub-optimal parent stock management affects the bottom-line will depend on the size of the decrease in heritability due to the environment and the intensity of selection normally practiced. In most industry circumstances the heritability will fall somewhere between the first two lines (h2 = 30% - 40%), which is a significant loss in bodyweight potential.

Figure 2. Change in average progeny weight after maleline selection with different realised heritability (h2).



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Early Selection of Parent Stock Toms

There are two factors that can cause a difference between the predicted selection response and the realised selection response. The first has been discussed in the selection of birds that have been poorly managed; the second is the selection at an age different to the intended slaughter age. In an ideal situation the parent stock selection age and slaughter age would correspond with management requirements. Costs to maintain a flock until later ages in operations with limited parent stock rearing space can mean that birds will be selected at younger ages. If birds are selected at younger ages, the correlation between the weight at the selected age and the desired age will be used for selection response. The further away the Parent stock age is from the desired slaughter age, the lower the correlation between the two weights and the greater the decrease in selection response at the appropriate age.

Figure 3 and Figure 4 show the average bodyweight gain for progeny of parent stock toms selected at 15 and 20 weeks of age, respectively. In both figures the gains in bodyweight at later ages is larger because the absolute variation present in bodyweight is greater in older, and consequently heavier, turkeys. When selection is at a younger age (Figure 3) the gain in bodyweight is greater with a gain of 0.44 lbs at 30% selection pressure, compared with 0.39 lbs at the same selection pressure when selected at 20 weeks (Figure 4). Conversely, when parent stock are selected at the later age of 20 weeks, the weight gain is greater in the later slaughter age class of 20 weeks with a gain of 0.87 lbs compared with 0.74 lbs when selected at 15 weeks. To summarise, by selecting at a younger age of 15 weeks the gains that can be achieved at a slaughter age of 20 weeks can be affected by on average 0.13 lbs per bird. Similarly, if the intended slaughter age is between 14 and 16 weeks then it would be prudent to select at a younger age, as weight gain at earlier ages is adversely affected if selection is at 20 weeks, but by a relatively smaller degree.

Figure 3. Change in average progeny bodyweight (lbs) at various slaughter ages with PS tom selection at 15 weeks.

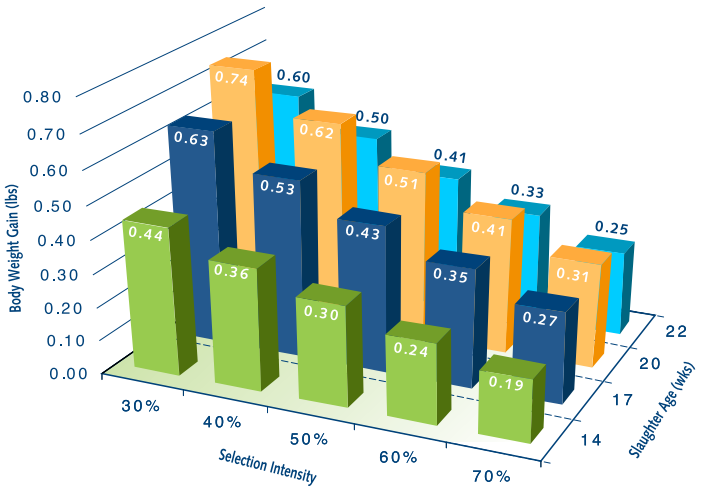
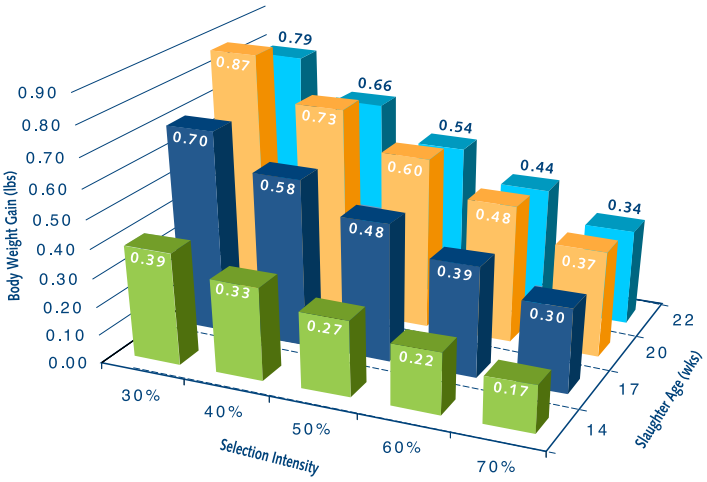


Figure 4. Change in average progeny bodyweight (lbs) atvarious slaughter ages with PS tom selection at 20 weeks.



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Determining the Optimal Selection Intensity

The level of selection intensity a multiplier breeder will use depends on the returns that are expected from selection, and the costs to achieve that selection intensity. Consequently, a cost-benefit analysis is the best way to determine the return on investment and calculate the optimum selection intensity to use. Returns can be calculated by two different methods and depend on whether the multiplier is part of a larger integrated company or is an independent commercial poult supplier. The first case is much easier to determine by the overall bottom line and profit per unit of turkey product processed. In the case of the independent poult producer, the return is harder to gauge because the premium that the market is willing to pay for selected or hyper-selected poults is a function of market forces and the willingness of the grower to pay a premium.

The Integrated Company

The success of the integrated poultry company (see Figure 5) should be judged by the profit per unit of product, and not the profitability of individual components in the production chain. By advocating any parent stock selection, poult cost will increase because of an increase in parent stock purchasing costs and the expense of feed and housing through rearing. The increased feed and housing expenses can be deferred to some extent through the income generated by the sale of processed non-selected birds. However, the added purchasing costs need to be offset against savings generated in the commercial grow-out and returns generated in the processing plant in final product.

When using a cut-off weight selection (i.e. truncation selection) the effect on bodyweight can be accurately predicted using the calculations used to produce Figures 3 and 4. What they do not show are the correlated effects that occur in other traits as a result of selection based on bodyweight. In particular, selection on bodyweight will have genetically correlated effects on improving feed conversion (FCR) and breast meat yield due to the increased weight and higher overall yield; there can, however, be a slight increase in mortality due the negative correlation between liveability and bodyweight. These need to be accounted for when determining the optimum selection point and cutoff weight for parent stock selection.

Figure 5 shows the increase in profit in ¢/lb delivered at the plant. Selection intensity is calculated as the number of parent stock toms used as a percentage of the number placed, assuming a 12% mortality from rearing to selection. The figure shows an increase in profit above that of no selection to an optimum intensity of 15%. Increasing the selection intensity above this point becomes increasing less profitable, as the cost of parent stock to achieve the 'hyper-selected' intensities above 10% adversely affect profit. All these calculations were based on an 'average situation' for an integrated company using Converter parent stock. The optimum intensity will vary between operations with factors such as mortality, parent stock cost, strain, processing costs, and product value all having an effect the optimum point of selection.

Figure 5. Change Increase in profit in ¢/lb delivered for an integrated enterprise at across different parent stock tom selection intensities assuming both toms and hens are processed.

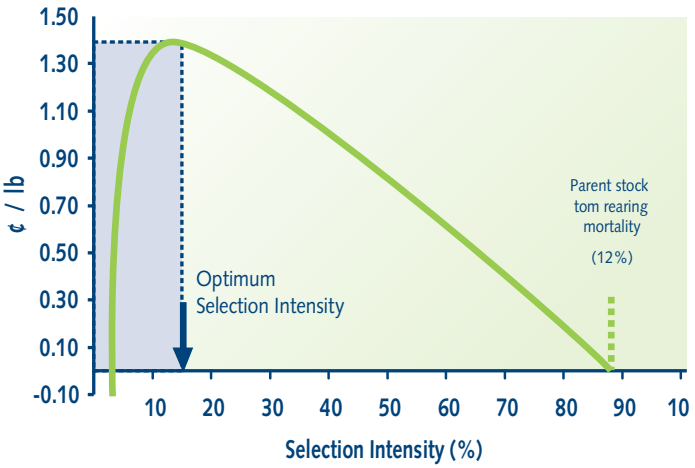
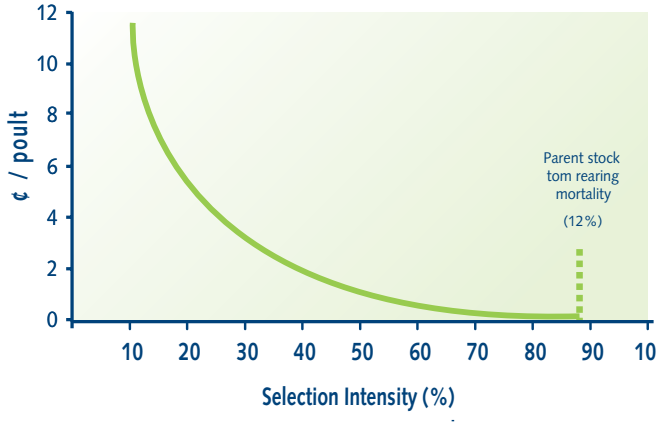


Figure 6. Increase in cost of production of a straight run poult above non-selection in parent stock toms.



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The Independent Poult Supplier

The independent poult supplier has a more difficult task in identifying the appropriate selection intensity as returns are generated in poult sales. Where appropriate, poult premiums may be included in the sale price of poults from parent stock that has been intensely selected that defray the costs of selection.

Figure 6 shows the increase in the cost of production of a straight run poult at different selection intensities through to an intensity of 10%. Beyond 10%, costs increase exponentially. Using both the additional costs of production (Figure 6) and the expected benefits that can be accrued in both the commercial situation from increased growth rates (as shown in Figure 2) and the processing plant from increased yield, the poult premium can be placed such that both supplier and grower benefit from parent stock selection. Additionally, parent stock selection provides a method by which the independent poult supplier can differentiate itself from the competition in product performance.

In Summary

From the scenarios that have been presented, it should be clear that parent stock selection can have a substantial impact on the bottom line of an integrated company. Parent stock selection should be optimised in order to maximise the returns generated from the strategy. The change in selection response by moving the selection and slaughter age closer together is substantial and the decrease in response should be accounted for with the possible savings from earlier selection. The case may be that the savings accrued in the breeding operation are lost many times over in the processing plant. The same can also be said of inadequate management of parent stock pre-selection with the losses multiplied many times over in production and processing because the optimal selection response was not achieved due to lowering the heritability of bodyweight selection. Once these processes (i.e. environment and age of selection) have been optimised, the next step is the optimisation of the selection intensity, which is a financial analysis of the returns generated from selection and the costs to achieve those returns. The scenarios described were all calculated with the Hybrid Production Simulator using 'average' production figures. Obviously, specific companies need to adjust their system to individual prevailing costs and market forces specific to that enterprise.

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