Leg Health in Commercial Turkeys

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Introduction

The role of the primary breeder is to provide breeder and commercial turkeys with superior health, fitness and meat production characteristics. This is accomplished through continued genetic improvement of pure pedigreed lines supplying great grandparents, grandparents and parents. Typically it takes 4 years for the results of selection at pedigree level to reach the commercial birds.

Genetic improvement is accomplished through maintaining a complete pedigree and by applying a balanced selection approach for health, welfare and efficiency traits. The pedigree is used achieve selection accuracy, to avoid inbreeding and allow continued genetic variation within the pure lines. Traditional breeding methods require collection of phenotypic data of all key traits – commercial and welfare. Phenotype or observed bird performance results from a combination of genetics, stockman- ship, housing, nutrition and health factors. It is only the genetic component, explaining typically from 10% to 30% of the observed variation, which can be utilised to permanently improve a breed. However, the stockman-ship, housing, nutrition and health factors, explaining the majority of variation, are extremely important considerations. The phenotypic data is combined with family information to estimate genetic breeding values for all traits in the most accurate manner. Balanced selection considers all traits in line specific combinations to improve the relevant commercial traits such as growth, yield, or reproduction while ensuring the health and robustness through skeletal integrity and liveability.

In modern poultry breeding programs, breeding values for growth and leg health traits are estimated at the same time to allow improvement of both traits simultaneously, accounting for any genetic relationships between those traits.. When pedigree candidates are chosen, only those individuals without any physical defects and favourable breeding values and genetic potential for both traits go on to produce the next generation. A large gene pool is maintained, with more than 40 lines (including 14 colour variants) to maintain genetic diversity. This diversity, coupled with genetic variation within the lines, allows for several combinations to be made to produce healthy and robust commercial crosses.

Selection for Leg Health and Fitness

Aviagen Turkeys' breeding programme has a long history of phenotypic selection for leg health, with walking assessment of individual turkeys, and culling for leg defects and poor walking ability since the 1970's. This has allowed continuous but moderate progress in leg health, in line with the low heritability of leg health traits (10-15% of observed variation explained by genetics).

In 2006, Aviagen Turkeys implemented a multi-trait family genetic selection for a wider range of leg health traits, which includes:

- Gait scoring – each pedigree turkey is assessed for walking ability using the 5 point 'Bristol system' (Kestin et al, 2002)
    - The criteria includes a composite of achieving good posture (bird standing upright), good stride and correct step length in free flowing movement.
- Leg defect scoring of the birds when walking (scoring valgus/varus type defect) – with automatic elimination if defect is present.
- Use of real-time X-ray methodology to eliminate incidence of Tibial Dyschondroplasia (TD), a malformation of the bone which is characterised by an avascular plug of abnormal cartilage in the growth plate of long bone particularly the proximal tibiotarsus. (Orth & Cook, 1994).

Gait scoring and assessment of leg defects are methodologies used to eliminate *clinical* signs of leg health issues. The inclusion of the information on x-ray images of the bone of the turkeys provides a powerful method of also eliminating *sub-clinical* leg issues.

While all of these traits are considered in addition to growth and reproductive traits when selecting pedigree candidates, Aviagen Turkeys applies an extremely stringent policy with regards to leg defects. Selection candidates with either clinical or sub-clinical leg defects are automatically removed from the breeding programme hence do not contribute to future generations.

The moderate estimates of heritability displayed in table 1 (estimated by VCE6, Groeneveld, 2010) indicate it is possible to select individuals based on breeding values for these traits and expect improvement in the phenotypic performance and genetic potential of their offspring.

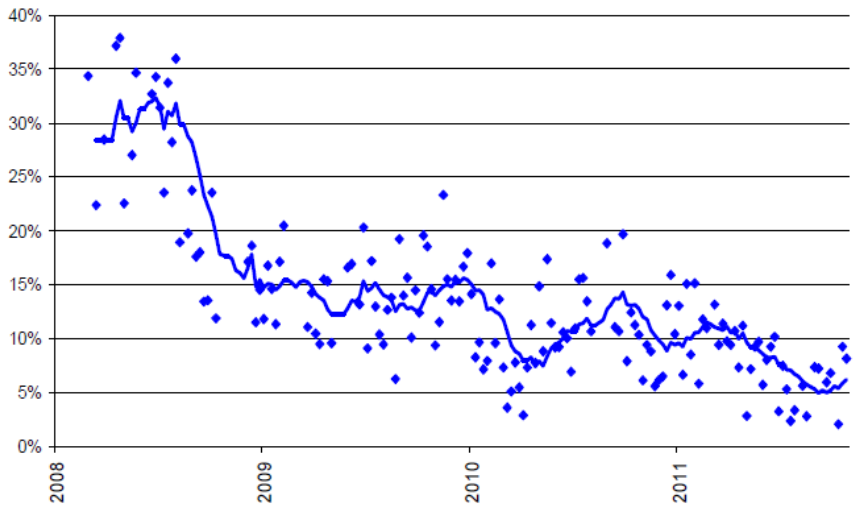
Table 1: Genetic parameters for growth and leg health traits; heritability on the diagonal, genetic correlation above the diagonal, standard errors in parentheses

	BW14	BW18	CS18	Gait	Leg Defect	TD
BW14	0.544 (0.016)	0.957 (0.003)	0.820 (0.011)	-0.469 (0.031)	0.468 (0.030)	0.100 (0.031)
BW18		0.492 (0.014)	0.836 (0.010)	-0.428 (0.031)	0.451 (0.028)	0.037 (0.037)
CS18			0.289 (0.010)	-0.569 (0.026)	0.550 (0.026)	0.135 (0.027)
Gait				0.147 (0.006)	-0.845 (0.024)	-0.362 (0.049)
Leg Defect					0.110 (0.005)	0.165 (0.039)
TD						0.194 (0.024)

Key - BW14=body weight 14 weeks, BW18= body weight 18 wks, CS18=Conformation Score (1 poor to 5 good) 18 weeks, Leg Defect = Composite of valgus/varus defects

An example of this improvement achieved can be seen in the incidence of TD in a population of heavy male line males (figure 1). At the onset of measuring TD using X-ray, 35% of the pedigree males showed sub-clinical or clinical TD. By estimating breeding values for TD and including these values in routine selection, the incidence rate has been reduced to less than 10%.

Figure 1. Phenotypic incidence of Tibial Dyschondroplasia in Male Line Pedigree Males contributing to commercial turkeys



Maximising Impact of Pedigree Selection on Field Performance

One of most important considerations for any breeder is to ensure that the high genetic progressachieved at the pedigree level will be transmitted successfully to the commercial animals. In other words, the selection programme for the breeder needs to be set up such that genetic progress is maximised while Genotype by Environment Interaction (GxE) is minimised (Mulder & Bijma, 2005). Two effective strategies to achieve this are 1) to have a selection environment that is a good reflection of the environment that the birds would encounter in the field, and 2) measure selection traits using technologies that allow accurate prediction of breeding values for traits correlated to the birds' field performance.

A powerful way to quantify the genetic progress transmitted from pedigree to commercial animals is to actively measure the exact same traits used in the pedigree programme but at the commercial level, and compare the responses. This is relatively straightforward for some of the key performance traits like growth rate and feed conversion ratio.

Health traits in contrast are more difficult to quantify as they are affected to a higher extent by environmental factors. However, given the importance of such health traits to overall welfare and production then quantification has to be a clear focus for the breeders. To drive this, Aviagen Turkeys has commenced a programme of field surveys on turkey health traits and the first area which is presented here surveys incidence of TD.

Commercial Turkey Leg Health Survey

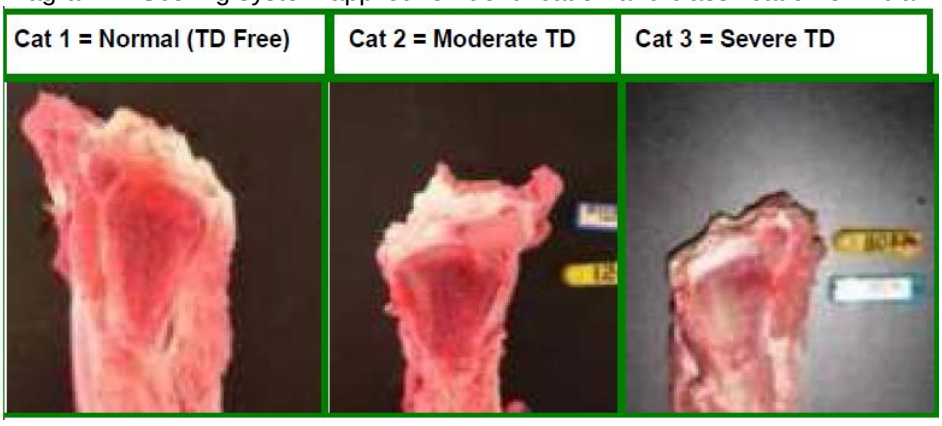
The commercial turkey leg health survey was conducted over the years 2011 and 2012, across two major German turkey companies and three different strains, namely Standard, Alternative 1 and Alternative 2. In order to keep the survey as standardised as possible and avoid environmental noise, the farm structure and season were replicated across the years.

The measurements taken in the survey included body weight at 16 weeks, body weight at 21 weeks, percentage breast meat yield, foot pad dermatitis incidence and TD incidence at 16 weeks of age. Both males and females were assessed in this study. The TD incidence was measured by utilising the Lixiscope X-ray method as applied in the pedigree programme. The categories, also illustrated in Diagram 1, were;

1) Normal - TD free
2) Moderate TD - less than 10% cartilage coverage of the surveyed Tibiotarsus area and
3) Severe TD – cartilage coverage higher than 10% of the surveyed Tibiotarsus area.

The above categories appear as different bone densities when the measurement is applied, and can be readily identified due to differences in light intensity in the generated scope reading. The same person conducted the survey at both locations and in the pedigree programme, thus avoiding any effect of different operator effects.

Diagram 1. Scoring system applied for identification and classification of Tibial Dyschondroplasia in Turkeys.



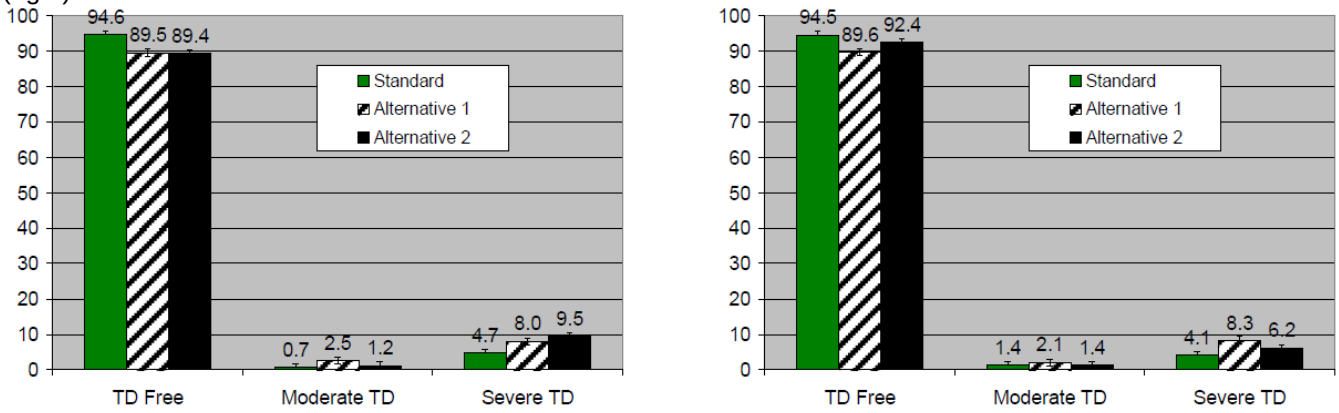
Results

1) Strain Comparisons

The results from the strain comparison surveys for commercial turkeys are presented in figure 2 and 3. An important finding in these studies was that TD is limited to males only, all females were 100% free from TD. Therefore, all results reported below are based on findings in male commercial turkeys only.

Overall the alternative strains showed higher degree of TD incidence compared to the standard strain within the two companies participating in the survey. Both companies were showing similar levels of TD incidence for the standard strain (94.6% and 94.5% freedom from TD respectively) indicating good level of repeatability. There was no phenotypic relationship between development of TD lesions and body weight (which is in line with the lack of genetic relationship with body weight at 18 wks as presented in table 1).

Figure 2 & 3. Incidence of Tibial Dyschondroplasia in Commercial Turkey Males in Company 1 (left) and Company 2 (right).



2) Validation of Genetic Progress

One of the key criteria for efficient selection is how the selection progress that is made at pedigree level is disseminated to the commercial birds, as described in the introduction. To assess the genetic progress achieved in TD, it is possible to compare the trends within pedigree and translate this to predicted progress in the field. This means looking at progression of TD incidence in the pure lines making up the end commercial and predicting impact in the commercial bird.

Overall the progress in 2011 versus 2012 leg health surveys showed a significant increase in the percentage entirely TD free, this increased from 85.4% to 94.6% (Figure 4). This can be directly attributed to the first impact of implementation of a targeted selection against TD using X-ray technology in the breeding programme.

These results are highly encouraging as they are either in line or even exceeding the genetic expectation for progress in leg health (by 1.6%) as shown in table 2. This provides evidence of a successful transmission of genetic progress, and represents a great improvement in leg health, which has been achieved simultaneously with improvement in feed efficiency and meat traits.

Figure 4. Comparison of TD Survey Results 2011 vs. 2012

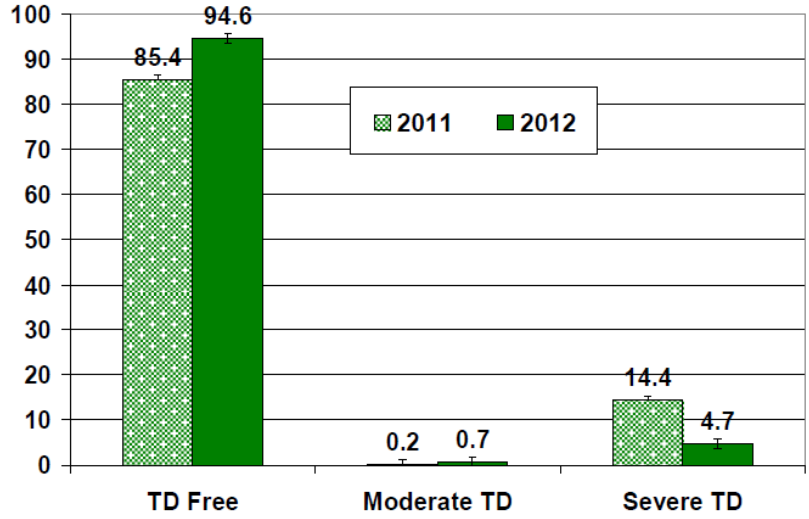


Table 2: Comparison of actual achieved progress for TD Freedom in Commercial Turkey males vs. predicted progress in same trait from pedigree performance

Year	Actual	Predicted	Difference
2011	85.4	85.0	+0.4
2012	94.6	93.0	+1.6
Improvement	+9.2	+8.0	

Conclusions

Aviagen Turkeys operates a balanced breeding programme where fitness and health traits are considered in addition to production characteristics. In the selection objective more than 1/3 of all selection pressure is dedicated to welfare and health traits, ¼ dedicated to reproductive traits and the remainder mainly to the feed efficient meat selection.

Significant advances have been made in leg health selection through use of gait scoring, leg defect scoring and use of X-ray techniques in multi-trait family selection. This has given a clear response in leg health on pedigree level, with an improvement in TD, moving from 65% to 90-95% TD freedom in the space of 4 years.

The unique leg health surveys that have been reported here are a useful tool to compare pedigree and end commercial turkey performance and assess the pedigree programme efficiency. Evidence shows that the progress achieved at pedigree level for male TD freedom is successfully being transmitted to the field performance, with 2012 commercial males being in excess of 94% TD free.

Aviagen turkeys are fully committed to the European industry with regards to participating and supporting research into management and genetics to increase health and welfare in turkey production. The leg health surveys presented in this paper will continue as part of our European turkey health monitoring.

References

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