Current research by NSW Agriculture on the genetics of flystrike resistance

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Summary

This review describes research projects conducted currently by NSW Agriculture targeted at the development of Merino breeding programs for commercial producers and ram breeders that incorporate flystrike resistance. Outcomes from these projects will include additional information on the mode of inheritance of flystrike resistance and the development of integrated breeding programs for resistance. Projects are planned to: estimate genetic differences in fleece rot resistance from industry sources; estimate genetic parameters involving resistance to body strike and fleece rot resistance; describe selection responses in body strike and fleece rot resistance; identify markers for major genes for resistance; evaluate different strategies to include resistance in Merino breeding programs; and evaluate the use of marker-assisted selection for resistance in Merino breeding programs. Existing technology transfer initiatives are also described.

Keywords

Resistance, flystrike, body strike, fleece rot, Merino

Introduction

NSW Agriculture at Trangie is currently conducting a number of research projects towards an improved understanding of the genetics of flystrike resistance. Outcomes from these projects will include additional information on the mode of inheritance of flystrike resistance and the development of integrated breeding programs for resistance. Overall, these projects will allow the development of Merino breeding programs that incorporate flystrike resistance in both commercial and ram breeding flocks. This review provides descriptions of these projects and summarises the progress made to date. Body strike, and its precursor fleece rot, is the form of flystrike of major interest in these projects.

Mode of inheritance of flystrike resistance

Genetic differences in fleece rot resistance from industry sources

For commercial producers, information is needed on comparative performance of Merino bloodlines in fleece rot resistance to assist them in their choice of bloodline. For ram breeders, improved reporting of fleece rot information recorded in Central Test Sire Evaluation would enable superior sires in fleece rot resistance to be identified. Using industry sources of data, statistical analyses will examine the ability to estimate reliably genetic differences between Merino bloodlines (wether comparison data) and sires (Central Test Sire Evaluation data).

To date, only bloodline differences in fleece rot resistance have been examined. Eleven comparisons across New South Wales and Victoria have been identified as recording fleece rot scores on wethers, with a range of 1 to 4 years of records per comparison. Preliminary analyses of data available from four of these wether comparisons are reported by Mortimer and Atkins (2001) and showed that it is possible to use wether comparison data to estimate bloodline differences in fleece rot severity. Significant differences in fleece rot severity, but not fleece rot incidence, between bloodlines were found for 22 bloodlines. Bloodline means were estimated with limited precision. Consequently more data is needed to provide more useful and reliable information on bloodline differences in fleece rot resistance for commercial producers. Organisers of future wether comparisons will be encouraged to score fleece rot on each animal. In future analyses, the availability of additional data will allow the examination of alternative analytical methods (e.g. generalised linear, threshold and Bayesian models) for their ability to

better account for the discontinuous distribution of the data and to avoid the possibility of apparent bloodline interaction that may be due only to scale effects (Mortimer and Atkins, 2001).

Genetic parameters involving resistance to body strike and fleece rot

Estimation of breeding values for body strike and fleece rot resistance and the prediction of selection responses requires a more complete set of genetic parameters (Mortimer 2001): estimates of the level of phenotypic variation, heritabilities, and genetic and phenotypic correlations. Derived from Merino genetic resource flocks run at Trangie, data from the multiple-bloodline project (Mortimer and Atkins, 1989) and the Trangie QPLU$ project (Taylor and Atkins, 1997) will be analysed using a range of models to provide genetic parameters for body strike and fleece rot resistance. In particular, the genetic and phenotypic correlations of body strike and fleece rot resistance with production, quality and indicator traits will be estimated. The QPLU$ data will allow relationships to be estimated which are applicable to contemporary Merino breeding programs. The opportunity then exists to combine these parameter estimates with published estimates from other research flocks in an analysis to obtain average estimates of genetic parameters involving body strike and fleece rot resistance. Estimates from this analysis could then be added to genetic parameters for selected wool production and quality traits that have been derived in this way by Atkins (1997).

Selection responses in resistance to body strike and fleece rot

The Resistant and Susceptible selection lines were established to evaluate the ability of direct selection to alter resistance to fleece rot and body strike (McGuirk *et al.*, 1978). The selection criteria used within the lines has varied across years and included natural expressions of fleece rot and body strike and induced expressions of fleece rot and body strike following fleece rot induction (Raadsma, 1985). Differences between the lines in fleece rot and body strike incidences have been observed under both low risk (Raadsma, 1991a) and high risk (Raadsma, 1991b) environments. Mortimer *et al.* (1998) showed that the Resistant and Susceptible selection lines diverged at annual rates of 2.8% for natural fleece rot incidence and 0.4% for natural body strike incidence, with similar rates of divergence for the induced expressions of these traits. Selection was shown to result in unfavourable correlated responses in greasy and clean fleece weights, a favourable correlated response in fibre diameter and little change in yield and body weight. These responses in resistance in the Resistant and Susceptible selection lines will be examined in more detail, as well as the accompanying responses in reproduction and quality traits. Also, the QPLU$ data will be used to estimate responses in fleece rot resistance to joint selection on fleece weight and fibre diameter.

Identifying major genes for resistance to body strike and fleece rot

The availability of pedigreed data from the Resistant and Susceptible selection lines allows testing for the effects of possible major genes on fleece rot and body strike resistance through segregation analysis. Earlier segregation analyses, using a regression procedure, of these data by Mortimer *et al.* (2000) provided inconclusive evidence on the possibility of major gene effects influencing these traits. However, more recent analyses of these data by Mortimer *et al.* (2001) suggested that the data were consistent with a model that includes a major gene influencing both resistance to fleece rot and body strike. These later analyses were based on a Markov Chain Monte Carlo algorithm that accounted for the discontinuous nature of the traits.

The segregation analyses are only able to indicate if the data and the pedigree support the possibility of a major gene being present in the population. Markers are needed to confirm that such a gene is present. The use of these selection lines to screen for markers for the resistance gene(s) is being explored as the next possible step for this project.

There is likely to be value in being able to select for major genes for resistance to fleece rot and body strike. Selection on phenotype may not always be possible as expression of these traits can be limited by environmental conditions. The difficulty of assessing resistance in the paddock may be overcome by the availability of markers for any major gene effects influencing resistance, particularly for those environments where incidences of fleece rot and body strike vary across years. Resistance could also be assessed at any age. As well, markers for major gene

effects on these traits could be used by ram breeders who breed rams, which are rarely or not challenged by these diseases, to be sold and used in commercial flocks in environments of greater challenge from fleece rot and body strike. Identification of a marker for these disease traits in the selection lines could also allow the possible introgression of the gene(s) for resistance into ram breeding flocks using a DNA test.

Technology transfer initiatives

To complement the research projects described above, a number of technology transfer initiatives have recently occurred. A revised Agfact (Murray and Mortimer, 2001) and poster series describing the scoring of sheep for fleece rot are now available. Three Agnotes on breeding flystrike resistant sheep targeted at ram breeders and commercial producers have also been produced (Joshua and Mortimer, 1999a; Joshua and Mortimer, 1999b; Joshua and Mortimer, 2000). The breeding technology package, 'Breeding and Selection – a commercial focus' developed by Hatcher and Bayley (1999), provides a workshop format to develop the breeding skills of commercial breeders and their understanding of the factors which influence profitability. The workshop consists of six modules and is supported by a detailed manual and hands-on sheep selection exercises. More importantly, it can be tailored to address the specific breeding issues of a particular group such as issues associated with breeding for flystrike and fleece rot resistance.

Integrated programs for resistance

Inclusion of resistance to body strike (or fleece rot) in the objectives of Merino breeding programs can be achieved by using an economic analysis to derive an economic value to be given to the trait (Ponzoni, 1984; Atkins, 1987; Cottle, 1996) or alternatively a 'desired gains' approach, as used to include internal parasite resistance in Merino breeding programs (Woolaston, 1994). The ability of these different methods to include resistance to body strike and fleece rot in Merino breeding objectives will be evaluated. Different selection strategies then will be evaluated for their ability to make genetic progress towards breeding objectives that include all traits that influence profitability. Different selection processes (including selection directly or through indicator traits and use of additional performances) will be investigated. This will include assessment of the likely contributions of marker-assisted selection to genetic progress.

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