BRIEF COMMUNICATION: Artificial Insemination success rates for Meat and Wool New Zealand Central Progeny Test sires

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INTRODUCTION

National progeny testing schemes have become important components of national sheep genetic improvement programmes in Australia, France, and New Zealand (Fogarty *et al*., 2002; Bibé *et al*., 2002; Campbell *et al*., 2005). In 2001 the Alliance Central Progeny Test was established, this was combined in 2005 with the Elite Lamb Progeny Test to become the Meat and Wool New Zealand Central Progeny Test (CPT). Over the past six seasons, a total of 120 leading industry sires, comprising 14 different breeds, have been mated via artificial insemination. CPT rams are genetically connected via common sires used across sites and years. They are also widely used in industry flocks. Artificial insemination, using laparoscopic insemination with fresh or frozen semen (LapAI), allows efficient widespread use of these leading sires. However, industry LapAI conception rates in sheep are variable and factors affecting these rates are still poorly understood. This paper examines factors affecting the success of LapAI in the current study and contrasts them with results from other species.

MATERIALS AND METHODS

The CPT has been run on the AgResearch, Woodlands Research Farm; Lincoln University, Ashley Dene Pastoral Systems Research Farm and On Farm Research Limited, Poukawa Farm with the first matings commencing in 2002, 2003 and 2005 at the three sites, respectively. Rams were selected for use in the CPT by contacting breed societies and sire reference groups, and asking them to nominate rams. Final selection was based on genetic connectedness to industry breeding groups. The ewe flock has been made up of predominately Coopworth or Composite ewes, with the latter having variable proportions of Texel, Finn, and East Friesian blood in addition to Romney or Coopworth.

Ewes were allocated to sires to obtain a minimum of 20 and 40 lambs per sire for terminal and dual purpose rams, respectively. All ewes were synchronised using a controlled internal drug releaser (CIDR) (CIDR-G, Pharmacia), and allocated to sires to obtain a minimum of 20 lambs per sire. CIDRs were inserted intravaginally for twelve days, after which time they were removed and vasectomised teaser rams, at approximately 30 ewes per ram, joined with the ewes. The teaser rams were fitted with a marker harness which marks the ewes mounted by the teaser indicating they are beginning to experience oestrus. The ewes which had been marked were identified and drafted off every four hours so they could be presented for insemination in order of coming into oestrus. Twenty four hours after the ewes had been marked by the teaser ram and drafted from the flock they were inseminated by a LapAI procedure. Ewes had no access to feed and water eighteen hours prior to insemination. Follow up rams were introduced no earlier than 10 days after insemination. Data for each surviving ewe were expressed as a binary trait depending on pregnancy status, logit transformed and analysed using a mixed model (SAS, 2006). Fixed effects investigated included effect of site/year, sire breed, operator, and fresh versus frozen semen, while sire was fitted as a random effect. Link sires were used across site/year allowing unconfounded estimates of both effects. Poukawa 2007 sire lambing records were removed from the analysis due to lack of LapAI link sires to leave 5,466 ewes mated to 113 LapAI sires in the final analysis.

RESULTS AND DISCUSSION

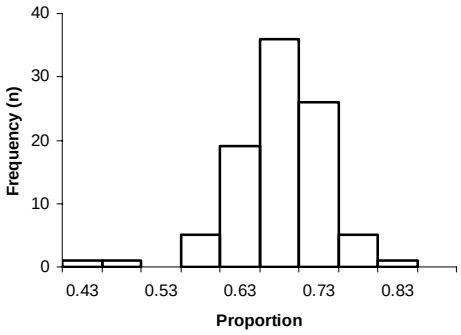
The proportion of ewes that held to artificial insemination across all site/year/sire combinations, ranged between 0.27 and 0.93 with an overall mean of 0.68 (Standard deviation = 0.13). Initial investigations showed that sire breed ($P = 0.18$), operator ($P = 0.55$) and fresh or frozen semen use ($P = 0.55$) had no significant effect in the current data set and were removed from the final model. The remaining factors of sire and site/year effects both had a highly significant impact on LapAI success rate ($P < 0.001$). The adjusted means corrected for site and year effects are summarised in Table 1 and the corrected sire estimates are summarised in Figure 1. The estimated size of the sire variance from the logit mixed model was 0.12 with a standard

error 0.03, compared to the residual variance for a logit distribution of 3.29 (Fahrmeir & Tutz, 1994). With the inclusion of permanent environmental and semen batch effects this provides an upper estimate for any genetic component of 0.04.

TABLE 1: Corrected estimates of site and year laproscopic artificial insemination success rates expressed as a proportion.

Site	Year	Mean	SEM
Ashley Dene	2003	0.42	0.05
	2004	0.66	0.03
	2005	0.81	0.03
	2006	0.83	0.03
	2007	0.80	0.04
Poukawa	2005	0.74	0.05
	2006	0.74	0.04
Woodlands	2002	0.61	0.03
	2003	0.71	0.03
	2004	0.74	0.03
	2005	0.70	0.03
	2006	0.61	0.03
	2007	0.61	0.03

FIGURE 1: Frequency distribution of back transformed individual sire estimates for proportion that held to AI after correction for site and year effects.



This study identified that the ram used within the CPT and site/year both influenced AI success rates with breed and fresh versus frozen semen not having a significant effect on the success rate. The causes for the sire differences, after correction for site/year effects, cannot be unambiguously assigned. They include semen collection and processing effects as well as permanent environmental and genetic differences. However, in the current context the commercial semen processing and collection procedures attempt to maximise post thaw motility with only mature rams that pass minimum semen criteria being used. We suggest that the majority of the variation observed from this study is therefore genetic in origin. This would be consistent with reports from fresh and frozen semen from other species (Gasteiger *et al*., 1981; Smital *et al*., 2005; Taylor *et al*., 1985) where heritability estimates of 0.20, 0.29 and 0.08, respectively, were reported. Macmillan (1979) in a review on dairy cattle fertility suggested that sire conception rate differences largely arise through post-insemination sperm survival. As the volume of data from this study increases we will be able to use genetic relationships between the individuals tested to disentangle these effects. Similarly, the underlying causes in site/year variation need to be explored further, perhaps via within site and year protocol variations. The maximal LapAI success rate of in excess of 0.8 observed in this study is similar to rates achieved through natural mating (Macmillan *et al*., 1998). These results suggest that if previous results are available, individual CPT sire LapAI conception rates could be considered when selecting sires for widespread industry use.

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