Application of genetics technology in the temperate Australian beef seedstock industry

L Corrigan[1], PF Parnell[2]

[1]Rennylea Pastoral Company, Old Rennylea, Bowna, NSW, 2642
[2]NSW Dept of Primary Industries, JSF Barker Building, University of New England, Armidale, NSW, 2351

Abstract

The application of genetics technology in the temperate Australian seedstock sector was considered via an examination of the trends in performance recording among the major breeds, an assessment of the rates of genetic progress in a set of example herds, and from the results of a small survey of leading seedstock breeders. There has been a trend towards increased application of genetic technology in the beef seedstock over the past 20 years. In particular, the BREEDPLAN technology has facilated the application of performance based selection. However, there is still an inadequate degree of performance recording to realise the potential rates of genetic improvement. Numerous issues were identified that need to be addressed in order to achieve greater application of genetic technology. Clearer price signals back to seedstock breeders, more efficient data management systems, and better industry communication appear to be key determinants of the future adoption of genetic technology.

Introduction

The Cooperative Research Centre for the Cattle and Beef Industry (Beef CRC I) made a substantial contribution to the development of the quantitative parameters fundamental to genetic improvement in the Australian beef industry (Bindon, 2001). The subsequent Cooperative Research Centre for Cattle and Beef Quality (Beef CRC II) completed much of this research and provided a further understanding of the genetics of meat quality and feed conversion efficiency (Burrow and Bindon, 2005). The new Cooperative Research Centre for Beef Genetic Techniologies (Beef CRC III) has a key focus on developing DNA based tools to assist in accelerating the rate of genetic progress. The adoption of genetic technology by the Australian beef industry will be a key determinant of the future economic benefits delivered by the three phases of the Beef CRC to the national economy (G. Griffith, pers. comm.)

The application of genetic technology by the seedstock sector is the key driver of genetic progress in the beef industry. Genetic gains made in the seedstock sector are eventually disseminated across the entire industry, influencing the profitability of each individual beef enterprise. A critical factor is how long it takes the seedstock sector to adopt research outputs once they have been proven to contribute to the profitability of the beef supply chain. Many of the genetics outputs of Beef CRC I and Beef CRC II have been incorporated into BREEDPLAN, the international genetic evaluation system developed by Australian scientists at the Animal Genetics and Breeding Unit, Armidale (Graser et al., 2005). This enables the efficient adoption of much of the genetic research outputs, and shortens the adoption lag common with many innovations.

This paper considers the application of genetics technology in the temperate Australian beef seedstock sector in three ways. Firstly, we examined the trends in the degree of performance recording in the major breeds represented in temperate Australia. Secondly, we examined the estimated rates of genetic improvement over the last decade for a sample of herds known to be enthusiastic adopters of genetic technology. And, thirdly, we conducted a survey amongst the leading seedstock breeders in temperate Australia to identify the key issues and challenges they face in the application of genetic technology.

Materials and Methods

1. Breed performance recording trends

Data on the registration and performance recording statistics over the period from 1985 to 2003 were obtained from the Agricultural Business Research Institute (ABRI) for major beef breeds used in temperate Australia. ABRI maintains the pedigree registers for the majority of beef breeds in Australia and operates the National Beef Recording Scheme (NBRS) for the processing of performance data using BREEDPLAN. The breeds represented in this study included Angus, Hereford, Poll Hereford, Shorthorn, Murray Grey, Charolais, Limousin and Simmental. Together,

these eight breeds account for about 85% of all performance records processed on BREEDPLAN for Australian clients (J. Allen, pers. comm).

The number of male and female calves that were either not performance recorded, or recorded for various combinations of traits included in BREEDPLAN, was determined for each calf birth year from 1985 to 2003. Trends in the number of Net Feed Intake (NFI) and IGF-I tests submitted for BREEDPLAN analysis (Moore et al., 2005) were also examined.

2. Performance recording and genetic trends in example herds

Performance recording statistics for calves born over the period from 1990 to 2003 were collated for four seedstock herds known to be enthusiastic adopters of genetic technology. Two Angus herds, one Poll Hereford herd and one Charolais herd were chosen as the example herds. Genetic progress in these herds was assessed by examining the trends in average BreedObject $Index Values (Barwick et al, 2005) for representative selection indexes published by respective breed associations. The selection index used to assess progress in the Angus herds was the Japan B3 Index (Angus Australia, 2006). Genetic progress in the Poll Hereford herd was assessed by the trend in $Index Values for the Hereford Prime Index (Australian Poll Hereford Association, 2006), and the Charolais herd was assessed by trends in the Charolais Supermarket Index (Charolais Society of Australia, 2006).

3. Survey of seedstock producers

A survey of 80 beef seedstock breeders was conducted to obtain opinions of the issues that they were concerned with and challenged by in the business of producing genetics for the modern beef industry. The breeders surveyed had a reputation as influential individuals who have adopted performance recording and genetic improvement technology. They represented several breeds, including Angus, Hereford, Poll Hereford, Shorthorn, Murray Grey, Charolais, Simmental, Devon, and Composite. The breeders were asked to rank the importance of a range of nominated issues and breeding technology on a scale from 1 (not important) to 10 (very important). They were also invited to provide comments on these issues. In addition, they were asked to list the top three challenges/issues that they considered the beef seedstock sector would face over the next 7 years, and requested to comment on possible solutions/ assistance that might overcome these challenges.

Results

1. Breed performance recording trends

Figure 1 shows the trends in the total number of performance records for various traits collected in the Angus, Hereford, Poll Hereford, Shorthorn, Murray Grey, Charolais, Limousin and Simmental breeds over the period from 1985 to 2003. There has been a general trend towards increased performance recording over time. The fluctuations between years are likely to be due to variable seasonal and economic conditions.

At the time of data extraction the greatest number of performance records over this period was recorded for calves born in 2002. Among the 128,104 registered calves born in the eight breeds in 2002 there were 76,654 birth weight records, 79,008 200-day weight records, 70,092 400/600-day weight records, 41,540 ultrasound eye muscle area (EMA) and rib/rump fat depth records and 39,844 ultrasound intramuscular fat percentage (IMF%) records. There were 13,369 registered male calves and 16,762 registered female calves with no performance records.

Figure 2 shows the trends in the total number of male and female calves born between 1985 and 2003 that were recorded for different trait combinations. There were a greater number of male calves than female calves registered in all years, but similar proportions of calves in each sex tended to be recorded for different traits. Among male calves born in 2002, 22% had no performance records, 14% had only birth weight recorded, 16% had only 200/400 or 600-day weights recorded, 23% had birth weight and 200/400 or 600-day weights recorded, and 25% had birth weight and 200/400 or 600-day weight and ultrasound EMA and rib/rump fat depth recorded. The corresponding numbers of female calves was 25% with no performance records, 13% with only birth weight recorded, 18% with only 200/400 or 600-day weights recorded, 24% with birth weight and 200/400 or 600-day weights recorded, and 21% with birth weight and 200/400 or 600-day weight and ultrasound EMA and rib/rump fat depth recorded.

Recording of NFI and IGF-I data for the computation of NFI EBVs commenced in the late 1990s. Approximately 400-500 NFI test results were submitted per year from 1999 to 2000, with a peak of 501 animals tested in 2002. The number tested in 2004 had declined to 401 animals. The majority of NFI tests have been associated with research projects (e.g. Arthur et al., 2001). They have mainly included Angus animals, with a small number of Poll Hereford and Shorthorn animals also represented. In contrast, the number of animals IGF-I test results has dramatically increased from about 300-400 per year during 1998 to 2000 (also mainly from research projects) up to over 6,500 tested in 2004. Again, the majority of the IGF-I tests were for Angus animals, with only small numbers from each of the other major breeds.

2. Performance recording and genetic trends in example herds

The trends in number of performance records collected in the four example herds for calves born

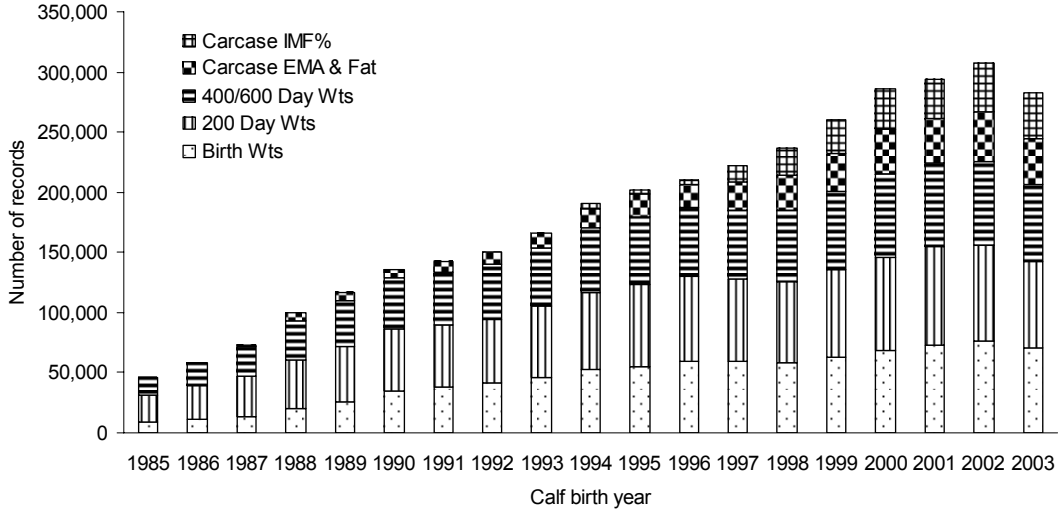

Figure 1. Trends in the total number of performance records for various traits collected in the major beef breeds in temperate Australia (Angus, Hereford, Poll Hereford, Shorthorn, Murray Grey, Charolais, Limousin and Simmental).

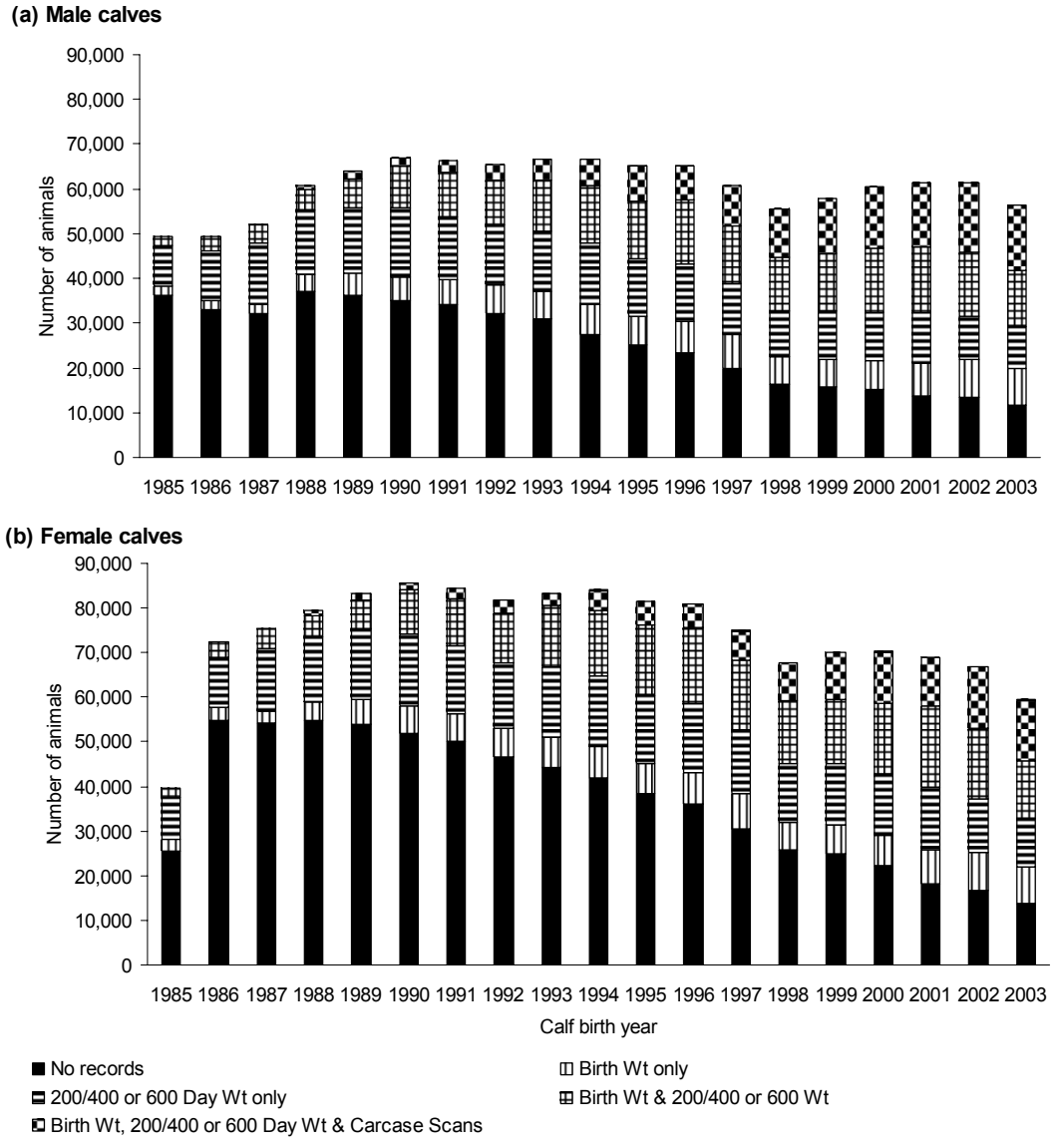

Figure 2. Trends in the total number of male and female calves recorded for different trait combinations in the major beef breeds in temperate Australia (Angus, Hereford, Poll Hereford, Shorthorn, Murray Grey, Charolais, Limousin and Simmental).

over the period from 1990 to 2003 are shown in Figure 3. The trends in average $Index Values for calves born in these herds from 1996 to 2003 are shown in Figure 4, together with the corresponding breed trends for each selection index. Whilst it is not valid to directly compare the actual $Index Values across different breeds, the greater slope of the $Index Value trend in the Angus breed indicates a faster rate of genetic change in this breed relative to the other two breeds represented.

Herd 1 (Angus) has conducted comprehensive recording of the major BREEDPLAN traits on all male and female calves since 1990. Ultrasound scan measurements of EMA and fat depth commenced in the early 1990s, and ultrasound IMF% scans were adopted when this technology became available in the late 1990s. The herd has expanded considerably in size since 1998, with 400-500 calves recorded per year during the period from 1999 to 2003. About 63% of calves over this period were by AI sires, with 29% resulting from embryo transfer. The herd achieved an average genetic trend of +$7.07/cow.year for the Angus B3 Index over this period (c.f. breed average of +$3.90/cow.year). During the previous 5 year period (1994 – 1998) the herd achieved an average genetic trend of +$3.66/cow.year for the Angus B3 Index (c.f. breed average of +$2.64/cow.year).

Herd 2 (Angus) has been established more recently, but also has conducted comprehensive recording of all male and female calves for all major BREEDPLAN traits. Approximately 350-400 calves were recorded per year during the period from 1999 to 2003. About 39% of the calves over this period were by AI sires. The herd achieved an average genetic trend of +$6.49/cow.year for the Angus B3 Index over this period. During the previous 5 year period (1994 – 1998), the herd achieved an average genetic trend of +$2.39/cow.year for the Angus B3 Index.

Herd 3 (Poll Hereford) has also conducted comprehensive performance recording of all male and female calves since 1990, including ultrasound measurement of carcase traits as this technology became available. This herd has been in a gradual expansion phase since 1999, with 250-350 calves recorded per year during the period from 1999 to 2003. About 35% of these calves by AI sires. The herd achieved an average genetic trend of +$1.32/cow.year for the Hereford Prime Index over this period (c.f. breed average +$0.66/cow.year). During the previous 5 year period (1994 – 1998), the herd achieved an average genetic progress of +$0.95/cow.year (c.f. breed average of +$0.87/cow.year) for the Hereford Prime Index.

Herd 4 (Charolais) has been gradually expanding the number of calves performance recorded since the mid-1990s. In this herd male calves are comprehensively recorded for growth and ultrasound EMA and fat depth. There is no recording of IMF% in this herd, as marbling is not generally considered to be a trait of interest in the Charolais breed. Female calves are recorded for growth traits only, with the exception of a few years during the mid-1990s when ultrasound EMA and fat depth measurements were also recorded. Only a portion of calves each year have birth weights recorded in this herd. About 400 calves were recorded per year during the period from 1999 to 2003. About 36% of these calves were by AI sires, with 12% resulting from embryo transfer. The herd achieved an average genetic progress of +$0.68/cow.year for the Charolais Supermarket Index over this period (c.f. breed average +$0.59/cow.year). During the previous 5 year period (1994 – 1998) the herd achieved an average genetic progress of +$0.36/cow.year (c.f. breed average of +$0.34/cow.year).

3. Survey of seedstock producers

There were 38 respondents to the survey, including breeders of Angus (22), Poll Hereford (6), Hereford (3), Shorthorn (3), Murray Grey (3), Devon (3), Composite (3), Charolais (2), Limousin (2), Simmental (1), and Red Angus (1). Seven of the respondents had more than one breed included in their seedstock enterprise. In total, the survey respondents marketed approximately 4,500 bulls per year.

3.1 Traits recorded

The performance traits recorded by the survey respondents included birth weight, calving ease scores, 200/400/600-day weights, mature cow weights, ultrasound carcase scans of EMA, fat depth and IMF%, scrotal size, pregnancy tests, structural scores, NFI, IGF-I, temperament scores, flight time, Genestar marbling, Genestar tenderness, serving capacity, and hair type.

The breeders were asked to nominate which traits they regularly recorded in their seedstock herd. Of the 26 breeders who answered this question, 16 breeders (62%) weighed all calves at birth, 5 breeders (19%) weighed most calves at birth, 4 breeders (15%) weighed at least some calves at birth, and one breeder did not weigh any calves at birth. A relatively easy trait to measure such as 200-day weight had a higher participation rate with 20 breeders (77%) weighing all calves at 200 days and 6 breeders (23%) weighing most of their calves. Fourteen breeders (54%) recorded ultrasound carcase scans on all of their yearlings and 11 breeders (42%) recorded scanned most of their animals. Fifteen breeders (58%) recorded structural scores on most animals and 13 breeders recorded either temperament scores or flight times on most animals. Five of the breeders (19%) routinely tested all calves at weaning for IGF-I, and 3 breeders (12%) indicated that they were testing

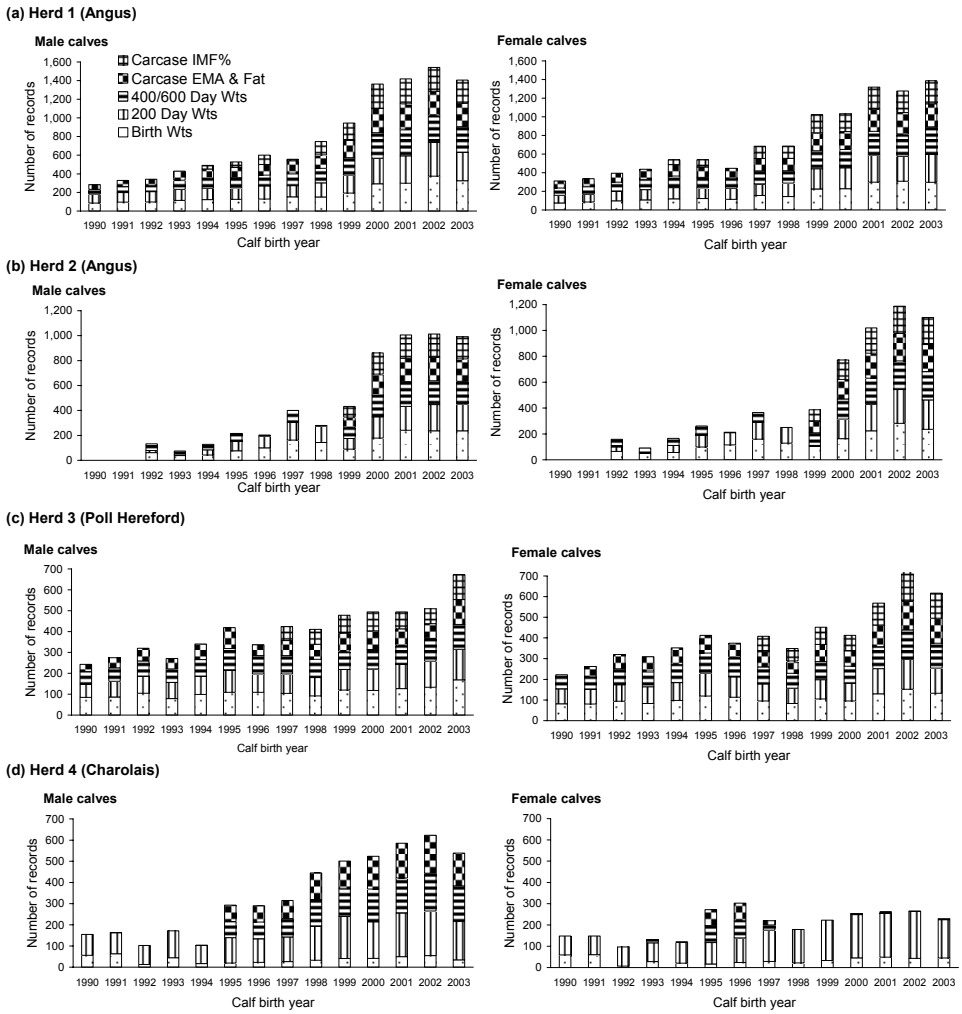

Figure 3. Trends in performance records collected in example herds (a) Herd 1 (Angus), (b) Herd 2 (Angus), (c) Herd 3 (Poll Hereford) and (d) Herd 4 (Charolais).

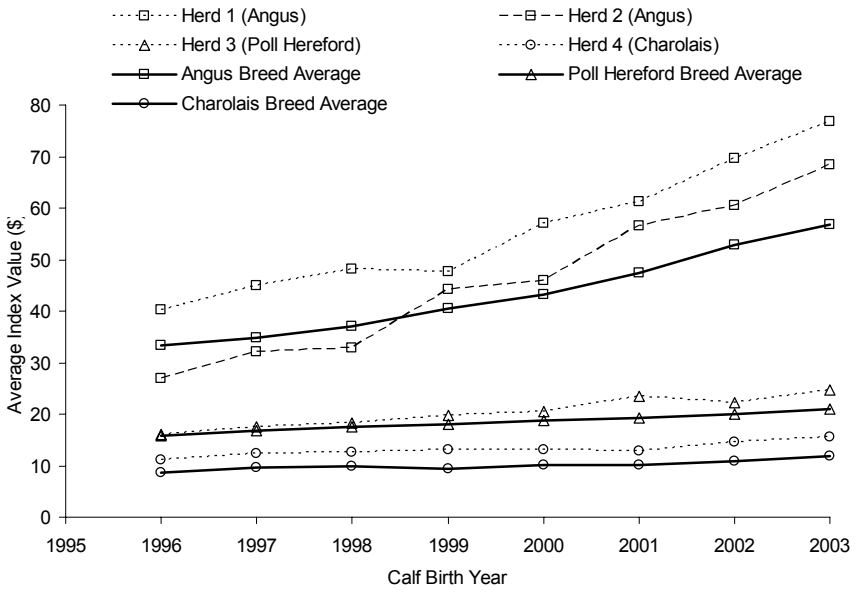

Figure 4. Trends in the average $Index Values for standard breed selection indexes in each of the Example Herds, and the corresponding breed average trend for each index (Angus Japan B3 Index; Hereford Prime Index; Charolais Supermarket Index).

at least some of their calves for IGF-I. Nine breeders (35%) had tested at least some animals for either the Genestar marbling test or the Genestar tenderness test.

Table 1. Average score1 given by breeders of the importance of different traits to meet the future market demands and production environments of their seedstock customers. Total of 38 respondents.

Trait	Score	Trait	Score	Trait	Score
Temperament	9.0	Feed Efficiency (cow herd)	8.2	Carcase yield	7.7
Structural soundness	8.9	(growing/finishing)	8.1	Tenderness	7.5
Calving Ease	8.8	Growth	8.1	Marbling	6.7
productivity	8.7				

[1] score from 0 (not important) to 10 (very important)

Table 1 shows the average rating given by the survey respondents to a list of nominated traits for their importance in meeting the future market demands and production environments of their customers. All of the nominated traits were ranked by the breeders as important (i.e. average score > 5). Overall, marbling was ranked at the lowest of those traits.

In response to the question asking which traits were most important for the future profitability of their customers 18 breeders (47%) suggested feed efficiency; 17 breeders (45%) suggested fertility, calving ease and/or maternal productivity; 14 breeders (37%) suggested eating quality, tenderness and/or marbling; 13 breeders (34%) suggested growth; 8 breeders (21%) suggested structural soundness; 7 breeders (18%) suggested carcase yield and/or muscling; 6 breeders (16%) suggested temperament; and, one breeder suggested polledness.

3.2 Importance of genetic technology

Table 2 includes the average rating given by the survey respondents of the likely future importance of nominated technology in their breeding program. Ultrasound carcase measurement and artificial insemination rated the highest. Tools to monitor genetic progress, feed efficiency testing, selection indexes, embryo transfer, DNA markers, structural scoring and tools to assist in mating allocations were all considered to be important (in declining order of importance). Tools to minimise inbreeding were considered to be relatively unimportant.

When asked to nominate which technology would have the biggest impact on their herd's future genetic progress 16 breeders (42%) suggested either artificial insemination or DNA assisted selection; 9 breeders (24%) suggested embryo transfer; 8 breeders (21%) suggested genetic evaluation (i.e. BREEDPLAN); 7 breeders (18%) suggested either ultrasound carcase evaluation or feed efficiency testing; 5 breeders (13%) suggested selection indexes; 4 breeders (13%) suggested carcase feedback; 3 breeders (8%) suggested either tools for monitoring genetic progress or tools to assist in mating allocations; 2 breeders (5%) suggested either cloning or structural scoring; and at least one breeder suggested either sexed semen, progeny testing or automated weighing.

Table 2. Average score1 given by breeders of the likely importance of different technology in their breeding program over the next 7 years. Total of 38 respondents.

Technology	Score	Technology	Score
Ultrasound carcase trait measurement	8.9	Embryo transfer	6.6
Artificial insemination	8.9	DNA markers	6.5
Tool(s) to monitor genetic progress	8.0	Structural scoring	6.3
Feed efficiency testing	7.8	Tool(s) to assist in mating allocations	5.5
Selection Indexes	7.1	Tool(s) to minimise inbreeding	4.5

[1] score from 0 (not important) to 10 (very important)

3.3 Data collection and management

The majority of the breeders (34; 89%) indicated that they used a computerised data management system. In response to a question asking what is the most challenging aspect(s) of data collection and management in their seedstock enterprise 17 (45%) breeders suggested the time/cost of measurement, recording and transferring data to computer; 8 breeders (21%) suggested software problems/limitations and/or lack of computing skills; 7 breeders (18%) suggested calf birth weighing; 2 breeders (5%) suggested NFI testing; one breeder suggested breed society demands for DNA parentage verification; and, one breeder nominated the time taken for mating allocations.

3.4 Sources of information

Table 3 shows the average ranking given by survey respondents of the importance of different sources of information to assist in their breeding decisions and in the long-term planning of their seedstock business.

Commercial clients, other seedstock producers and ABRI were rated as the most important sources of information to assist the survey respondents in their breeding decisions. The Beef CRC was rated as the most important source of information for their long-term business planning. Veterinarians were rated as important for asssisting in long-term planning, but were not considered important sources of information to assist in breeding decisions.

When asked to comment on the availability/ quality of information available to assist in the development of their seedstock enterprise 17 breeders (45%) suggested the need for better access to more focused information. Specific comments included the following: information is currently too dispersed;

Table 3. Average score1 given by breeders of the importance of different sources of information to assist in (a) their breeding decisions and (b) their long-term business planning. Total of 38 respondents.

Information source	Score (a)	Score (b)	Information source	Score (a)	Score (b)
Commercial clients	7.7	6.1	Breed Association	4.3	5.1
Other Seedstock Breeders	6.3	5.4	Private consultant(s)	3.9	5.0
ABRI	6.2	5.3	Print Media	3.8	5.3
Beef CRC publications	5.9	7.1	Vets	3.8	6.6
Specialist Schools, seminars	5.5	4.1	Government Extension Officer	2.7	3.4
Semen distributor	5.1	3.6	Stock Agents	2.6	3.3
Ultrasound scanning technician(s)	4.5	4.1			

[1] score from 0 (not important) to 10 (very important)

information needs to be more focused on critical issues of importance to commercial production; information needs to be more proactive, not reactionary; need improved access to information via the internet; need better access to research results from Beef CRC and MLA; and, need more specialised schools/conferences targetted at seedstock breeders. Three survey respondents (8%) emphasised the decline of "independent" information sources. It was suggested that much of the industry information is influenced by vested interests, and that it is difficult to obtain independent information, especially with decline in government extension services.

Seven breeders (18%) commented on the need for better/more performance information for the selection of animals. Specific comments included the following: paucity of well described performance recorded animals in some breeds to provide better and more accurate selection options; too much "subjective" information currently used in breeding decisions; need multi-breed EBVs; need more information on carcase/meat quality performance; need better information on the accuracy of selection indexes under different environments.

3.5 Future challenges and issues

3.5.1 Individual seedstock enterprises

In response to the request to list their key needs to overcome the challenges/issues facing their beef seedstock business over the next 7 years the most common issue, listed by 13 breeders (34%), related to the need to reduce the costs associated with performance recording (registration, DNA testing, NFI testing, BREEDPLAN fees etc.), especially by making it simpler and more labour efficient. Several of these breeders also commented on the need for improved software and data interfaces for managing the increasing amount and complexity of pedigree and performance data.

Ten breeders (26%) commented on the difficulty in defining appropriate breeding goals due to the uncertainty of future markets. The long time lag from decision making to the realisation of outcomes from breeding was mentioned as an impediment to the investment in genetic technology. Ten breeders also mentioned the need for greater financial reward to cover the increasing costs associated with producing improved seedstock.

Nine breeders (24%) mentioned the need to make greater use of available technology (e.g. carcase feedback data, ultrasound scanning, DNA markers) to improve beef eating quality, tenderness, product consistency and carcase yield. Nine breeders also mentioned the need for validation of the accuracy of EBVs to address common industry concerns about issues such as the lack of consistency between some EBVs and observed performance, the occasional large swings in some EBVs, the influence of pedigree information versus actual data (e.g. on carcase EBVs), the influence of correlations between some traits (e.g. birth weight and growth; RBY% and IMF%), the accuracy of Calving Ease EBVs, and the validity of "mid-parent" EBVs.

Eight breeders (21%) mentioned the need to increase the amount of performance data contributing to EBVs, the need to continue to develop new/more EBVs (e.g. longevity, maternal productivity), and the need to improve contemporary group reporting to increase the accuracy of EBVs.

Seven breeders (18%) mentioned the need to provide assistance in assessing the value of new breeding technology (especially DNA technology), taking into account the advancing age and modest level of education of many seedstock producers.

Six breeders (16%) emphasised the importance of multi-trait balanced breeding based on objective data to counter the widespread focus on single trait selection and "fads".

Five breeders (13%) suggested the need for more education and training programs for seedstock producers to achieve a greater level of understanding of the importance of objective measurement and the effective use of performance data. It was suggested that the slow acceptance of EBVs and $Indexes in some breeds has resulted in extremely slow genetic progress; and, that advanced schools/workshops are needed for seedstock producers, including the coverage of business skills.

Four breeders (11%) mentioned the need to validate the accuracy and validity of selection indexes. At least 4 breeders also mentioned the following needs: development of safer and easier methods for performance recording (especially calf birth weights) due to increasing labour OH & S requirements; more cost-effective methods/tools to enable selection for improved feed conversion efficiency; further evidence to convince commercial

breeders and feedlots of the benefits of genetic improvement, in order to realise a profit from investment in performance recording (especially NFI testing); and, improved flow of information, price signals and data back through the supply chain to seedstock producers.

Three breeders (8%) specifically mentioned the need for multi-breed EBVs to enable the industry to harness the benefits of breeding crossbred/ composite cattle.

Two breeders (5%) suggested a need for effective international genetic evaluation to enable the identification of improved genetic material from the global gene pool, plus better quality assurance of imported genetics to ensure that it is structurally sound and suited to Australian production environments. Two breeders also mentioned the need for increased availability of suitable genetic material for market focused breeding objectives. One breeder suggested the need for better mechanisms to protect the "security" of genetic material once cloning technology becomes readily available to the industry; and, one breeder suggested the need to retain/verify breed "purity" in order to maintain "true to type" breed performance.

3.5.2 The beef seedstock sector

In response to a request to list the key needs to overcome the challenges/issues facing the beef seedstock sector over the next 7 years the most common issue, listed by 21 breeders (55%), related to the need for the beef industry to continually reduce the per unit costs of production to remain internationally competitive. It was suggested that this is becoming more difficult due to the increased requirement to conform to more sustainable farming and grazing practices; the movement of cow-calf operations to more marginal rainfall zones with higher incidence of drought conditions; and, the overwhelming influence of external factors (e.g. global demand, low cost competitors, exchange rate fluctuations, market power of supermarkets & processors, increased regulatory and QA costs).

The next most important issue, mentioned by 11 breeders (29%) was the need to maintain biosecurity to protect the industry from exotic disease threat.

Eight breeders (21%) emphasised the need to meet trends in consumer demand to maintain competiveness of beef with other food commodities. Eight breeders also mentioned the need for more efficient and equitable systems for seedstock marketing, especially for small enterprises.

Seven breeders (18%) suggested the need for better education of commercial producers about beef husbandry (e.g. nutrition, health), basic genetic principles (e.g. appropriate use of EBVs) and market requirements. Seven breeders also suggested the need for greater incentives to attract young people to become involved in beef seedstock production. It was suggested that it is currently very difficult to recruit and retain experienced staff with the necessary aptitude for performance recording and the willingness to work long hours and weekends during calving and AI/ ET programs. Seven breeders emphasised the need to address the over-supply of seedstock when cattle prices are strong, causing imbalance between supply and demand. It was pointed out that the growth of alternative industries has reduced the demand for beef seedstock in some regions.

Six breeders (16%) suggested the need to practice and promote the clean, green and safe production of Australian beef (e.g. reduce/eliminate use of growth promotants, antibiotics; improve residual chemical monitoring, traceback).

Four breeders (11%) suggested the need for a mandatory beef grading system (e.g. MSA) linked to value based marketing to improve quality and consistency of beef. Four breeders also emphasised the need for an effective and progressive industry R&D program with rapid adoption of outcomes by industry. Four breeders also suggested the need to increase the average scale of seedstock operations to maintain enterprise viability. It was mentioned that this is difficult due to the high cost of land and lack of suitable lease country. As a result it was suggested that the beef seedstock sector will eventually lose many midsize producers and become dominated by the "big players" and the "hobby bull breeders".

Three breeders (8%) suggested that there was a need to reduce administration costs of breed societies, including amalgamation of services where possible.

One breeder emphasised the need to maintain a strong live export industry to ensure a satisfactory domestic price structure for beef. One breeder also suggested the need to prepare for the potential flow-on from unfavourable publicity about genetically modified crops and the potential perception that beef genetic improvement is equivalent to "genetic modification". One breeder also suggested the need for a body to facilitate and support the international marketing and export of beef genetic material.

Discussion

The trend of increased adoption of performance recording in the seedstock sector of the major temperate beef breeds since the introduction of BREEDPLAN in 1985 is a positive result for the Australian beef industry. Almost 80% of all registered animals in the seedstock herds that were born in 2003 had some degree of performance recording. However, it is a concern that only

25% of male calves and 20% of female calves had complete recording of birth weight, growth and ultrasound carcase data. These levels of complete recording are suboptimal for achieving rapid genetic progress in future profitability in the Australian beef industry. There is a need to identify the underlying causes for the low levels of complete recording and address these causes in order to lift the overall rate of genetic progress. This is particularly important when we consider that genetic improvement across the entire beef supply chain is ultimately determined by the gains made in the seedstock sector.

The trends in the $Index Values shown for the breeds and example herds considered in this study illustrate the excellent potential for achieving genetic progress from the adoption of genetic technology. The combined use of comprehensive performance recording and artificial breeding (particularly AI) has resulted in genetic trends in the example herds which significantly exceeded the average trends for the respective breeds. Barwick et al. (2005) compared the rates of genetic gain for 23 different breed level indexes that addressed profitability across a range of breed x market systems. They found that breeds with more performance recording generally showed greater rates of genetic gain.

The results of the small survey of leading seedstock breeders indicated that the costs associated with performance recording, the time taken in data management, inadequate animal recording software, and the lack of confidence in the accuracy of some EBVs are all likely impediments to the adoption of more complete recording in the seedstock sector. These breeders nominated that the need to reduce the per unit costs of production was the key challenge/issue for the future of the beef seedstock industry. Clearly, it is likely that the seedstock breeders will be unwilling to invest in expensive genetic technology in the future unless thay can be convinced of the resultant economic benefit to their individual businesses.

The survey respondents generally rated traits expressed in the breeding herd higher than end-product traits as important for the future profitability of their seedstock customers. Temperament, structural soundness, calving ease, maternal productivity and feed efficiency in the cow herd were all rated higher than feed efficiency during growing/finishing, growth, carcase yield, tenderness and marbling. This is likely to be at least partially due to the inadequacy of market signals back to seedstock producers to reward emphasis on genetic improvement in end-product traits. It also indicates that seedstock breeders will be reluctant to adopt new technology aimed at genetic improvement of end-product traits (e.g. DNA markers for meat quality traits) unless thay are confident that this will not have any adverse affect on traits of importance in the breeding herd.

Freer et al. (2003) identified that the primary constraints to adoption of beef breeding technology included the lack of "proof of profit" drivers, the lack of followup (assistance with adoption) after exposure to awareness programs, the difficulty of extension in a diverse and fragmented industry, and the decline in extension capacity. In the current study, the surveyed breeders rated traditional extension services (e.g. government extension officers, veterinarians, consultants and breed associations) at the low end of the scale as sources of information to assist in their breeding decisions. Several breeders suggested the need for better access to more focused information, for example, via the internet. The need for rapid and easy access to research results from the Beef CRC and MLA was also emphasised. Clearly, improved strategies for communication and extension will be necessary to achieve the necessary rates of adoption required for the industry to fully benefit from the potential of new genetic technology.

Conclusion

Whilst there has been a trend towards increased application of genetic technology in the temperate seedstock sector there is still inadequate levels of performance recording to achieve the potential rates of genetic improvement. Breeders surveyed in this study have identified numerous issues that need to be addressed in order to realise the potential benefits of new genetic technology. In particular, clearer price signals back to the seedstock sector, more efficient data management systems, and better industry communication strategies appear to be key determinants of the future adoption of genetic technology.

Acknowledgements

The assistance of Jack Allen (Agricultural Business Research Institute) in compiling the trends in performance recording, Wayne Upton (Animal Genetics and Breeding Unit) in providing genetic trend data, and the 38 respondents who contributed to the seedstock breeder survey, is gratefully acknowledged.

References

Angus Australia (2006) Understanding $Index Values. Available online at: www.angusaustralia.com.au (verified 10 February 2006).

Arthur PF, Archer JA, Johnston DJ, Herd RM, Richardson EC, Parnell PF (2001) Genetic and phenotypic variance and covariance components of feed intake, feed efficiency

and other post weaning traits in Angus cattle. Journal of Animal Science 79, 2805-2811.

Australian Poll Hereford Society (2006) POLL HEREFORD BREEDPLAN - Understanding the EBVs, Selection Indices and Accuracy. Available online at: www.pollhereford.com.au (verified 10 February 2006).

Barwick SA, Henzell AL (2005) Development success and issues for the future of deriving and applying selection indexes for beef breeding. Australian Journal of Experimental Agriculture 45, 913-921.

Bindon BM (2001) Genesis of the Cooperative Research Centre for the Cattle and Beef Industry: Integration of resources for beef quality research (1993-2000). Australian Journal of Experimental Agriculture 41, 843-853.

Burrow HM, Bindon BM (2005) Genetics research in the Cooperative Research Centre for Cattle and Beef Quality. Australian Journal of Experimental Agriculture 45, 941-957.

Charolais Society of Australia (2006) CHAROLAIS BREEDPLAN - Understanding the EBVs, Selection Indexes and Accuracy. Available online at: www.charolais.com.au (verified 10 February 2006).

Freer RE, Nicol DC, Upton WH (2003) A National Beef Genetics Extension Foresight Plan. A Report to MLA from the National Beef Genetics Extension Team. Second Edition, March 2003.

Graser H-U, Tier, B Johnston DJ, Barwick SA (2005) Genetic evaluation for the beef industry in Australia. Australian Journal of Experimental Agriculture 45, 923-933.

Moore KL, Johnston DJ, Graser H, Herd R (2005) Genetic and phenotypic relationships between insulin-like growth factor-I (IGF-I) and net feed intake, fat, and growth traits in Angus beef cattle. Australian Journal of Agricultural Research 56, 211–218.