Appendix 8 - Economic impact of pre-boosting strategies

EFFECTS OF YARD WEANING AND PRE-FEEDLOT VACCINATION ON FEEDLOT PERFORMANCE OF BOS TAURUS STEERS


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B Elizabeth Macarthur Agricultural Institute, PMB 8, Camden, NSW 2570
C NSW Agriculture, PO Box 123, Maitland, NSW 2320

SUMMARY

It was hypothesised that better weaning management, together with pre-feedlot vaccination, could reduce the incidence of Bovine Respiratory Disease (BRD) and improve feedlot performance.

Some 200 male beef calves (Angus x Hereford, and Hereford) were separated from their mothers at seven to nine months of age and allocated to one of three weaning treatment groups. The groups were matched for liveweight and any negative disease history. The treatments were (1) yard weaning with hay or silage; (2) yard weaning with hay or silage plus a novel handling procedure to train the animals to be able to find a grain ration in a trough; (3) paddock weaning without supplement or handling, according to common industry practice. Experimental vaccines against the major BRD pathogens were given to half of each group one to two months prior to entry into a large commercial feedlot. Performance in the feedlot was monitored up to slaughter after approximately 90 days on feed, with extensive serology to monitor disease transmission and detailed clinical and postmortem examination. This experiment was repeated over three production cycles.

The yard-weaned and yard-trained cattle had a significantly higher weight gain in the first month and over the 90 day feeding period than the paddock-weaned control groups. There was no difference between the groups in pre-feedlot weight gain. The yard-trained groups were not significantly different from yard-weaned. The vaccination treatment also significantly improved the weight gain in the first month and over 90 days. The combination of yard weaning and vaccination produced the highest weight gains overall. There was consistently lower morbidity in the yard-weaned groups compared to paddock-weaned controls. The morbidity in yard-trained groups was more variable, but overall it was intermediate compared with these two. The treatments did not, however, prevent losses due to a ‘late’ outbreak of BRD after 80 days on feed.

This method of weaning in small yards, coupled with the appropriate use of effective BRD vaccines one to two months before feedlot entry was shown to minimise sickness due to early respiratory disease and to improve productivity in the feedlot. Associated benefits are reduced risks of antibiotic residues and of animal welfare problems. This procedure was clearly cost-effective there being an increase in gross margin of up to $33 per head while costs increased by $5 to 15 per head. Benefits to the beef industry were estimated to be $8 million by 2001.

Keywords: feedlot cattle, weaning, vaccination, respiratory disease

INTRODUCTION

Bovine Respiratory Disease (BRD) has been shown to cause production losses and increased costs in Australian feedlots when feeder steers adapt poorly to their new conditions on arrival at the feedlot. This previous research (Dunn et al. 1993) showed that most respiratory disease occurred in the first four to six weeks after arrival at the feedlot and there was huge variation between pens in morbidity and mortality. It was hypothesised that better weaning management, together with pre-feedlot vaccination, could contribute to solving this problem and improve performance in the feedlot.

MATERIALS AND METHODS

Each year, during the autumn of 1993, 1994 and 1995, some 200 male beef calves were separated from their mothers at seven to nine months of age and subjected to various weaning treatments at the Elizabeth Macarthur Agricultural Institute (EMAI), Camden, NSW. After a further grow-out period of six to nine months on pasture at EMAI, these steers were transferred to a large commercial feedlot near Quirindi, NSW, where they were fed for about 90 days before slaughter. One to two months before entering the feedlot, selected animals were given specific vaccination treatments.
The experimental animals came from two main sources. About 60% were bred at EMAI while the remainder came mostly from one commercial property in the southern highlands of NSW. The majority were Angus x Hereford calves, but there was a significant number of Herefords also and a small number of other crosses. In the feedlot they were placed in a single pen, together with a similar number of comparable commercial-in-contact cattle, which were provided by the feedlot to ensure that a typical behavioural and infectious challenge occurred.

Prior to feedlot entry, measurements were made of the disease status, weight gain, responses to stress and the behaviour of these cattle. Health, weight gain and behaviour were closely monitored during the feedlot phase in order to determine the treatment effects and gain an understanding of the causal mechanisms involved. Offal and carcases were examined immediately after slaughter for effects of disease, and for meat quality attributes.

The experiment was repeated over three production cycles in order to refine the treatments. Ultimately, two types of yard weaning treatment were thoroughly tested, with and without the experimental vaccines, so that the most cost-effective combination could be determined. These experimental yard weaning procedures were compared with a control group which was paddock-weaned according to the common industry practice for Bos taurus cattle at the present time. The yards used for weaning were 14x14 m, each holding 50 calves of 180 to 260 kg liveweight (4m²/head).

The two types of weaning treatment were: (1) yard weaning for 10 days with good quality hay or silage, but no handling of the cattle during this time; and (2) the same yard weaning plus a novel handling procedure to train the animals to be able to find a grain ration in a trough (see Fell et al. 1997). The groups were known as yard-weaned, yard-trained and paddock-weaned controls.

The vaccination treatments, which were administered at times ranging between 77 and 13 days prior to feedlot entry, consisted of experimental vaccines against Pestivirus, Infectious Bovine Rhinotracheitis virus (IBR), Parainfluenza 3 virus (PI₃) and Pasteurelleae (P. haemolytica and P. multocida). These were experimental vaccines, not yet commercially available, but they were prototypes of vaccines which are now in an advanced stage of commercial development.

For the first two to three weeks in the feedlot detailed measurements of behaviour were made by direct observation and time-lapse video recording with infra-red lighting to enable surveillance of feeding behaviour during the night.

RESULTS

A more detailed account of all the results from this large study can be found in the official report to the funding body (Fell et al. 1997).

The production and health measurements summarised in Table 1 show that both the yard-weaned groups had significantly better feedlot performance than the paddock-weaned control group, but there was no significant difference between yard weaning and yard training. There was no significant difference between the groups in pre-feedlot weight gain.

The results presented here are from 1995 only. Results from the previous development phases generally supported these conclusions. In 1993 the trends were the same as 1993 for production and health measures, but the differences were smaller and not significant over 90 days, except for the beneficial effect of vaccination. Liveweight gain in the first month was significantly better for the yard weaning treatments than for paddock weaning. In 1994 there was a ‘late’ respiratory disease outbreak (after 80 days on feed) with associated mortalities in all groups, but morbidity was again lowest in yard weaned animals. Treatment

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>ADG (first month)</th>
<th>ADG (90 days on feed)</th>
<th>Morbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yard Weaned</td>
<td>1.54 a</td>
<td>1.45 a</td>
<td>5.9 a</td>
</tr>
<tr>
<td>Yard Trained</td>
<td>1.46 a</td>
<td>1.39 a</td>
<td>17.3 a b</td>
</tr>
<tr>
<td>Paddock Weaned</td>
<td>1.22 b</td>
<td>1.20 b</td>
<td>22.2 b</td>
</tr>
</tbody>
</table>

Values in the same column with different superscripts are significantly different (P < 0.05)
Appendix 8 - Economic impact of pre-boosting strategies

Effects on liveweight gain were not significant. There were no deaths in vaccinated cattle from the EMAI source, but the vaccines did not prevent deaths at this stage in cattle from the other source.

The measured feeding activity during the adaptation period (ie time spent at the feedbunk for individual animals) was greatest for yard-trained animals and significantly less for the paddock-weaned groups, but this difference did not persist beyond two weeks in the feedlot.

In the yard-trained groups it was possible to measure animal temperament by means of a confidence test (see Fell et al. 1997) and it is of interest to note that, if six animals with particularly bad temperament had been excluded from that feedlot group, its morbidity would have been 10.2% rather than 17.3% (see Table 1). The liveweight gain of a group of 18 animals classified as ‘shy’ by this test in Phase 3 was 1.22 kg/head/day compared to 1.43 kg/head/day for the remainder of the group.

Table 2 shows (Phase 3 data) that the combination of yard weaning and pre-feedlot vaccination produced the best feedlot performance and the paddock-weaned, unvaccinated (control) group was significantly worse than any other group in terms of liveweight gain.

The vaccination treatment also had a significant beneficial effect on liveweight gain. The overall comparison between vaccinated and unvaccinated animals was 1.43 vs. 1.35 kg/head/day (P < 0.05). Over all three years there was a consistent difference of 8% in favour of vaccinated animals. However, there was also significantly higher morbidity (as measured by % removals from pens) in the vaccinated groups, particularly in 1995 (see Table 2).

The liveweight gain of animals that were found to be sick during the trial was significantly less than that of healthy animals. This difference was less after 90 days on feed than it was in the first month, but it was still a significant difference (1.56 vs. 1.43, P < 0.05) when averaged over all three phases.

The treatments had no effect on fat depth or dressing percentage of the carcases.

Table 2. Average daily liveweight gain (ADG) (kg/head/day) in the first month and after 90 days on feed and morbidity (% of animals removed from the pen) for Bos taurus steers that had been either yard weaned, yard weaned with training, or paddock weaned six months prior to feedlot entry and treated or not treated with experimental vaccines against respiratory disease one month prior to feedlot entry

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>ADG (first month)</th>
<th>ADG (90 days on feed)</th>
<th>Morbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yard Weaned, Vaccinated</td>
<td>1.62 ^a^</td>
<td>1.46 ^a^</td>
<td>12.0 ^a^</td>
</tr>
<tr>
<td>Yard Weaned, Unvaccinated</td>
<td>1.46 ^b^</td>
<td>1.43 ^a^</td>
<td>0.0 ^a^</td>
</tr>
<tr>
<td>Yard Trained, Vaccinated</td>
<td>1.48 ^b^</td>
<td>1.44 ^a^</td>
<td>21.2 ^b^</td>
</tr>
<tr>
<td>Yard Trained, Unvaccinated</td>
<td>1.44 ^b^</td>
<td>1.35 ^b^</td>
<td>13.5 ^b^</td>
</tr>
<tr>
<td>Paddock Weaned, Vaccinated</td>
<td>1.45 ^b^</td>
<td>1.27 ^b^</td>
<td>25.9 ^b^</td>
</tr>
<tr>
<td>Paddock Weaned, Unvaccinated</td>
<td>0.99 ^c^</td>
<td>1.13 ^c^</td>
<td>18.5 ^b^</td>
</tr>
</tbody>
</table>

Values in the same column with different superscripts are significantly different (P < 0.05)

Economic analysis

This showed that all treatments improved the gross margin for feedlot finishing compared to the control (paddock weaning) treatment. The highest improvement in gross margin was in the yard-weaned group and the yard-weaned, vaccinated group where, using projected income levels and price levels, an improvement of $33 per head was achieved in the feedlot. On-farm costs of $5.50 per head for yard weaning alone or, perhaps, $15 with vaccination (the price of future vaccines was not known), must be deducted from this benefit giving an added value of $18 to $27.50 for feeder steers that are prepared in this way.

DISCUSSION

It is clear that weaning in yards had a beneficial effect on the feedlot performance of short-fed Bos taurus steers in these experiments. Possible reasons for this effect could be (1) the learned feeding behaviour resulting from yard weaning and training, (2) taming and quietening of temperamental animals during the yard treatments, (3) strengthening of social bonds between animals during the yard weaning and (4) greater familiarity with yards, troughs and human activity in yard treated groups. While each of these probably played some part, the results indicated that (1) and (2) were not major factors because additional training to find grain in a trough gave no extra advantage, vaccinated animals did not have greater feeding activity in the first two weeks and there were still temperamental animals in every group at the conclusion of the treatments.
Appendix 8 - Economic impact of pre-boosting strategies

The most likely explanation (based on observations of pair-bond formation and social behaviour in the feedlot pen) seems to be that stronger social bonds which developed between individual animals during yard weaning helped to protect these animals against the stress of adapting to the feedlot. It is planned to test this hypothesis in future experiments.

Although the vaccination against respiratory disease improved weight gain, presumably due to a reduction in subclinical and clinical disease, this was not reflected in the morbidity data based on the numbers of animals removed from the pen by the feedlot stockmen. However, some of the vaccinated animals identified for removal from pens were not clinically sick so it is possible they were exhibiting some side-effect of a successful immunological defence against infection. Further work is needed.

The suggestion of a relationship between animal temperament (measured at weaning) and both liveweight gain and morbidity in the feedlot agrees with and adds to Voisinet et al. (1997) and Burrow and Dillon (1997) and is certainly worthy of further investigation.

The economic advantage of yard weaning as carried out in this study and the use of vaccines against BRD that will be commercially available in the near future warrants consideration by beef producers who currently wean their calves by turning them out into a paddock with no further supplement or handling. However, additional training during yard weaning to find grain in a trough did not appear to be cost-effective.

ACKNOWLEDGEMENTS

This project would not have been possible without the professional collaboration of personnel from the Australian Meat Holdings Caroona Feedlot (in particular the Manager, Steve Mathers) and Nigel Nichols (the veterinary consultant to this feedlot). We are also indebted to Paul Andersen, Bill McKiernan and Greg Meaker of NSW Agriculture for various aspects of cattle management and to many laboratory staff at the Elizabeth Macarthur Agricultural Institute, in particular Fiona Bertus, for exceptional technical assistance and to Paul Nicholls for biometrical support throughout. The project was funded by the Meat Research Corporation and formed part of the Health and Welfare research program of the Cooperative Research Centre for the Cattle and Beef Industry (Meat Quality).

REFERENCES

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Reducing Feedlot Costs by *Pre-Boosting*: A Tool to Improve the Health and Adaptability of Feedlot Cattle

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REDUCING FEEDLOT COSTS BY PRE-BOSTING: A TOOL TO IMPROVE THE HEALTH AND ADAPTABILITY OF FEEDLOT CATTLE

Abstract

Bovine Respiratory Disease (BRD) is known to cause production losses and increased costs in feedlots when feeder steers adapt poorly to their new conditions on arrival at the feedlot. It was hypothesised that better weaning management, together with pre-feedlot vaccination, could contribute to solving this problem.

Some 200 male beef calves (Angus x Hereford and Hereford) were separated from their mothers at 7-9 months of age and allocated to one of three main weaning treatment groups. The groups were matched for liveweight and any negative disease history. The treatments were (1) yard weaning with hay or silage (2) yard weaning with hay or silage plus a novel handling procedure to train the animals to be able to find a grain ration in a trough, (3) paddock weaning without supplement or handling according to common industry practice. Experimental vaccines against the major BRD pathogens were given to half of each group 1-2 months prior to entry into a large commercial feedlot. Performance in the feedlot was monitored up to slaughter after approximately 90 days on feed with extensive serology to monitor disease transmission and detailed clinical and postmortem examination. This experiment was repeated over three production cycles in order to refine the treatments which, collectively, were known as pre-boosting.

The yard-weaned and yard-trained cattle had a significantly higher weight gain in the first month and over the 90-day feeding period than the paddock-weaned control groups. There was no difference between the groups in pre-feedlot weight gain. The yard-trained groups were not significantly different from yard-weaned. The vaccination treatment also significantly improved the weight gain in the first month and over 90 days. The combination of yard weaning and vaccination produced the highest weight gains overall. There was consistently lower morbidity in the yard-weaned groups compared to paddock-weaned controls. The morbidity in yard-trained groups was more variable, but overall it was intermediate compared with these two. Mortalities did not occur in pre-boosted cattle in phases 1 and 3, but during an acute IBR episode after 11 weeks on feed in phase 2, the pre-boosting treatments were less effective.

A method of weaning in small yards, coupled with the appropriate use of effective BRD vaccines 1-2 months before feedlot entry (i.e. pre-boosting) are recommended for feeder steers to minimise sickness and improve productivity in the feedlot. Associated benefits are reduced risks of antibiotic residues or animal welfare problems. This procedure was clearly cost-effective there being an increase in gross margin of up to $33 per head while costs increased by $5-15 per head. Benefits to the beef industry were estimated to be $8 million by 2001.

Appendix 8 - Economic impact of pre-boosting strategies
Executive Summary

This project addressed the problem of respiratory disease in feedlot cattle and the failure of feeder steers to quickly and successfully adapt to the changed conditions they encounter when they enter the feedlot. This is part of a larger issue: the need to meet product quality specifications more reliably and economically without risk of antibiotic residues or the threat of animal welfare concerns.

Previous MRC research (DAN.064) had shown that most clinical respiratory disease occurred in the first 4-6 weeks after arrival at the feedlot and there was huge variation between pens in morbidity and mortality. This suggested that multiple changes during the early weeks of adaptation in the feedlot and the lack of a specific, effective immune response which protected the mixed-source animals against new respiratory infections were the main predisposing reasons for this problem.

The two strategies chosen to investigate and address this problem were (1) better management of feeder steers at the time of weaning and (2) vaccination prior to feedlot entry with new experimental vaccines which protected against the major pathogens implicated in respiratory disease.

Each year, during the autumn of 1993, 1994 and 1995, some 200 male beef calves were separated from their mothers at 7-9 months of age and subjected to various weaning treatments at EMAI. After a further grow-out period of 6-9 months on pasture at EMAI, these steers were transferred to a large commercial feedlot near Quirindi, NSW, where they were fed for about 90 days before slaughter. One to two months before entering the feedlot, selected animals were given specific vaccination treatments also. The combination of the weaning management plus the pre-feedlot vaccination is referred to as pre-boosting.

Prior to feedlot entry, measurements were made of the disease status, weight gain, responses to stress and the behaviour of these cattle. Health, weight gain and behaviour were closely monitored during the feedlot phase in order to determine the effects of the pre-boosting treatments and gain an understanding of the causal mechanisms involved. Offal and carcasses were examined immediately after slaughter for effects of disease and meat quality attributes.

Ultimately, two types of yard weaning treatment were thoroughly tested, with and without the experimental vaccines, so that the most cost-effective combination could be determined. These experimental yard weaning procedures were compared with a control group which was paddock-weaned according to the common industry practice for Bos taurus cattle at the present time.

The two types of weaning treatment were: (1) yard weaning for 10 days with good quality hay or silage, but minimal handling of the cattle during this time and (2) the same yard weaning plus a novel handling procedure to train the animals to be able to...
find a grain ration in a trough. The groups were known as **yard-weaned**, **yard-trained** and **paddock-weaned** controls.

The vaccination treatments, which were administered at times ranging between 77 and 13 days prior to feedlot entry, consisted of experimental vaccines against Pestivirus, Infectious Bovine Rhinotracheitis virus (IBR), Parainfluenza 3 virus (PI3) and Pasteurelleae (P. haemolytica and P. multocida). These were experimental vaccines, not yet commercially available, but they were prototypes of vaccines which are now in an advanced stage of commercial development.

The experimental animals came from two main sources. About 60% were bred at EMAI while the remainder came mostly from one commercial property in the southern highlands of NSW. In the first year some cattle also came from another commercial property in the same area. The majority were Angus x Hereford calves, but there was a significant number of Herefords also and a small number of other crosses. In the feedlot they were placed in a single pen, together with a similar number of comparable commercial-in-contact cattle, which were provided by the feedlot to ensure that a typical behavioural and infectious challenge occurred.

The **yard-weaned** and **yard-trained** cattle had a significantly higher weight gain in the first month and over the 90-day feeding period than the **paddock-weaned** control groups. This difference was small in phases 1 and 2, but was a 21% advantage after 90 days on feed in the third and final phase. There was no difference between the groups in pre-feedlot weight gain. The **yard-trained** groups were not significantly different from **yard-weaned**, indicating that there was no advantage of the additional training to find grain in a trough.

The vaccination treatment also significantly improved the weight gain in the first month and over 90 days. This difference was only about 8% overall, but it was consistent. The combination of yard weaning and vaccination produced the highest weight gains in phases 1 and 3 (the phase 2 data were confounded in this respect and had to be ignored). In phase 3 the **yard-weaned, vaccinated** group was approximately 60% higher in early weight gain than the **paddock-weaned, unvaccinated**, control group, with all the other groups falling in between, but significantly different from either extreme.

The disease patterns observed throughout the project were representative of the patterns seen in other studies (e.g. DAN.064). In each phase there was extensive transmission of Pestivirus and BRSV in the period between induction into the feedlot and the first weighing and sampling at around day 35. Transmission of IBR also occurred during this period in phase 1 and phase 3. Phase 2 was quite different in that there was virtually no IBR transmission up to day 37, but extensive transmission after this, resulting in a severe respiratory disease episode in weeks 11 and 12 with associated mortality. The transmission of PI3 mostly occurred prior to feedlot entry.

As expected, the history of exposure to infection and the previous management
Appendix 8 - Economic impact of pre-boosting strategies

Experience of the cattle populations were major factors affecting the disease outcomes.

There was consistently lower morbidity in the yard-weaned groups compared to paddock-weaned controls. The proportion of yard-weaned animals pulled because of sickness was 2.0%, 4.1% and 5.9% or less than half that of paddock-weaned animals (5.4%, 10.2% and 22.7%) in each of the three phases. The yard-trained groups were generally intermediate between these two.

Mortalities did not occur in pre-booster cattle in phases 1 and 3 (there was one only in the paddock-weaned, unvaccinated group in phase 1). During the IBR disease episode which occurred in phase 2 after 11 weeks on feed there were some deaths in all groups. Neither yard weaning nor yard training protected against this. The only sub-group in which there were no deaths was the vaccinated group from the EMAI source. This suggests that the pre-boosting treatments were more effective against early respiratory disease than they were against an acute IBR episode occurring after a few months on feed.

There were many significant differences between the different sources of commercial-in-contact cattle and between the two sources of experimental cattle. These were interesting and could be related to the prior handling of the cattle in several cases, but being incidental to the design of the experiment, they must be interpreted with some caution.

There were significant treatment effects on the feeding activity of the cattle during the first two weeks in the feedlot. Both yard-trained and yard-weaned groups adapted to the ration in the feed bunk more quickly than control or commercial-in-contact cattle. There were significant differences in the stress responses of the cattle (measured by cortisol in blood) at different times, but no significant differences between treatment groups.

Behavioural testing of weaner animals during the yard training procedure enabled certain animals (8-17% of the group) to be identified as "shy" or lacking the normal level of confidence when placed in an intensively managed situation. These animals had higher stress responses and performed significantly worse in the feedlot than the remainder of their group in both morbidity and weight gain. This showed that it should be possible to develop a behavioural test to identify the animals which will have most difficulty adapting (and therefore become cost burdens in the feedlot) well before they are purchased for feedlot-finishing. It appeared that these particular animals would perform better in a pasture-finishing situation.

The extensive nature of the results obtained, including the information on stress and behaviour, provided some clues as to the causal mechanism whereby yard weaning and vaccination had these beneficial effects on weight gain and health. The learned feeding behaviour and taming of flighty animals during yard weaning were considered...
Appendix 8 - Economic impact of pre-boosting strategies

to have played only a minor role, whereas the strengthening of social bonds between animals seemed likely to be a major component of the mechanism whereby yard-weaned animals coped better with adaptation to the feedlot environment. The effect of the pre-feedlot vaccination coupled with the better coping ability of yard-weaned animals resulted in a lower level of subclinical disease and a better growth rate as a consequence of this.

These findings should impact particularly on the weaning and marketing practices of the Southern beef breeding sector of the industry. Yard weaning is not currently widely practiced and calves are often weaned directly into saleyards where they encounter considerable stress from mixing and handling. An increasing awareness of the value of yard-weaned on-property, feeder steers that can adapt quickly in the feedlot should contribute to the adoption of value-adding practices such as these. Integrating better steer management with the next stage of intensive feedlot finishing forms part of an emerging best practice for quality trading alliances between steer suppliers, feedlotters and the beef-consuming public.

The overall conclusion was that the method of weaning beef calves and whether or not they receive pre-feedlot vaccination against respiratory disease can certainly influence the subsequent health and weight gain of these animals in the feedlot. Clearly, a simple method of yard weaning which has been detailed here resulted in better weight gain and reduced incidence of respiratory disease than a fairly typical paddock weaning regime. It was also noted that additional training of calves to eat grain from a trough during weaning did not give a better result than straight yard weaning with hay or silage. A definite benefit in weight gain and respiratory health also resulted from the use of experimental vaccines 1-2 months prior to feedlot entry. The two procedures were synergistic in their effect in that the combination of the two produced the best overall result.

It was also concluded that these treatments would be cost-effective under a range of industry circumstances. Economic analysis showed that, in comparison to the gross margins for control animals, all treatments improved the gross margins per head when compared to the control. The best in terms of the highest improvement in gross margin were the yard-weaned, unvaccinated and the yard-weaned, vaccinated treatments where, using projected income levels and price levels, an improvement of $33 per head was achieved to the feedlot. Farmer costs of $5.50 per head for yard weaning alone or, perhaps $15 with vaccination, must be deducted from the feedlotter benefit because the feedlotters would have to offer a premium of at least this much for the cattle to make it worthwhile.

The economic analysis also showed that, with adequate extension and a positive response from feedlotters to offer premiums for producers to wean their cattle, a benefit to the industry of $8 million could be achieved by the year 2001.
Appendix 8 - Economic impact of pre-boosting strategies

This leads to the following general recommendation designed to increase the likelihood of producing feeder steers which adapt well when introduced to the feedlot, are equipped to combat the BRD infectious challenge and can therefore be expected to perform well in terms of both health and weight gain:

1. Use a method of weaning in small yards which has at least the major characteristics of the yard weaning procedure used in this project.

2. Use appropriate vaccines against respiratory disease (when these become commercially available) prior to feedlot entry to ensure that a protective immunity exists on arrival at the feedlot.
we know nothing about the feed intake during bouts of sickness, nor about the efficiency of feed conversion, both of which could be affected by the animals’ level of coping during adaptation to the feedlot.

The overall conclusion is that the main reasons for the beneficial effects of both yard weaning and vaccination are to do with improvements in the animal’s coping mechanisms when exposed to an adaptive challenge and a simultaneous infectious challenge during the early stages of a feedlot production regime. We still know very little about the immunological/neuroendocrine processes whereby better social coherence in the group can improve the adaptation of cattle to feedlots, particularly when combined with the effective use of protective vaccines. However, we now have a greater comprehension and awareness of the main factors which seem to be operating in this complex situation and this provides some clear directions for improved industry practice and also for future research.

**ECONOMICS**

Economic analyses for individual phases are fully reported in each of the phase reports contained in the appendices. As systems were developing and there were confounding livestock health problems in phase two, the following report is based primarily on the results from phase three with due regard for the consistency of results over all three phases.

Economic benefits were assumed to occur in a number of possible ways. These were:

- Faster weight gains in the feedlot.
- Lower livestock health costs due to less sick pulls in the feedlot.
- Less deaths in the feedlot.
- A higher proportion of finished stock making the higher priced target market.
- Higher growth rates can mean reduced times to finish cattle and increased throughput per annum for the feedlot.
- Faster turn-off time can lead to earlier payments and lesser interest charges on the investment in cattle.

Results showed (Tables 1a-d earlier in this report) that for phase 3 there was a significant improvement in weight gain for both yard weaning and training treatments compared to paddock weaning. This occurred both in the first month and for the 90 day feeding period. There was also a significant improvement in weight gain in phase 1 for yard weaning and training treatments in the first month of entering the feedlot. It has been assumed in the analysis that higher weight gain groups have consumed the same amount of feed as other treatments. In practice it is likely that higher weight gain groups have actually consumed more feed so that differences in gross margin performance may in fact be slightly overstated.
Reducing Feedlot Costs by Pre-Boosting: A Tool to Improve the Health and Adaptability of Feedlot Cattle

There were lower livestock health costs due to fewer sick pulls. In all three phases the percentage pulls due to sickness in the yard-weaned treatments was less than half of that in the paddock-weaned situation. It should be noted that in phase 3 the yard-weaned unvaccinated group did not have any animals pulled for sickness (see phase 3 report Table 9) and as a result there was no cost penalty applied in the calculations shown in Table 16 of the phase 3 report. Considering the overall picture in all three phases, this would appear to be a slight aberration and a cost of at least $2.50 per head for sick pen costs would be a reasonable estimate when the costs of other categories are examined.

There were actually lower sick pen costs for unvaccinated animals than for vaccinated animals (see Table 3e), but weight gain was consistently better in vaccinated groups, suggesting that the level of sub-clinical disease was reduced by vaccine treatment.

Due to the low occurrence of deaths in experimental groups, no significant differences in deaths can be attributed to treatments. There were no mortalities in phase 3 and sporadic mortalities in other phases. However, there were no deaths in any EMAI vaccinated treatments. A small difference in the percentage of deaths can have a moderate impact on the returns, however, the sensitivity analysis in phase 3 (see appendix 3, p.37) estimated a difference in average gross margin per head of $11 when death percentage was varied from 0.01% to 2%.

It is very difficult to place an estimate on the value of getting a higher proportion of stock into a target market. The value to the feedlot will depend on the target market, the price penalties or premiums and the tightness of specifications in making this market. Improvement in weight gains from treatment animals were only modest and it was considered that there would only be limited gains in this category. Premiums are paid for heavier cattle in some situations. In an example where cattle attract a 3 cents per kg dressed premium for being in excess of a target weight, the improvement in returns per head, where carcase weight is 200 kg, is $6.00. If an additional 5% make the premium grade the improvement in average gross margin per head is $0.30. The higher the carcase weight, the greater the bonus will be.

It must be noted that, in phase 3 (see appendix 3, Table 11, p.32), there was actually a premium price paid of 1 to 3 c/kg liveweight for the lighter control animals compared with the other treatments. This was because at the time of valuation, a premium was being paid for smaller carcases that suited the local markets. It is anticipated that this situation is unlikely to occur regularly in the future, but it must be acknowledged that market conditions can also prevail such that heavier animals attract a discount rather than a premium.

The phase 3 report (see appendix 3, Table 16) shows an improvement in gross margin of $33.43 for the yard-weaned unvaccinated treatment using a yardstick purchase price of $1.20/kg and a sale price equivalent to $1.30/kg liveweight. This improvement would reduce to $30.93 if sick pen costs of $2.50 as discussed above are
allowed. The gross margin improvement for the yard-weaned vaccinated treatment was similar at $33.16.

Faster turn-off was not a factor in this study. Stock were fed for a set period and all gains were made through increased liveweight performance.

To calculate the likely benefit to the industry from these pre-boosting treatments, any costs borne by the farmer in carrying out the treatments must be subtracted from the superior gross margin performance during the feedlot stage. In fact farmers would need to be convinced they are to receive the premium necessary to at least compensate them for the costs incurred to justify the expenditure. Feedlots will claim however, that in a market where there is choice, farmers may have little choice but to carry out the treatments if they wish to sell their cattle to the feedlot. Warranty, quality assurance and value-based trading are clearly issues at this point.

A summary of the difference in gross margin returns compared to paddock weaning (from the phase 3 report, Table 16) and the costs incurred by farmers (phase 3 report, Table 7) is shown in Table 6.

Table 6. Summary of difference in gross margin per head in feedlot stage (assuming feedlot purchase price is $1.20 per kg liveweight and sale price is $1.30 per kg liveweight) and treatment costs incurred at farm level ($ per head) (assuming vaccine cost of $9.08 - as this vaccine is only in the development phase it is impossible to determine the market price).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Paddock Weaned Vacci'd</th>
<th>Yard Weaned Vacci'd</th>
<th>Yard Weaned UnVacci'd</th>
<th>Yard Trained Vacci'd</th>
<th>Yard Trained UnVacci'd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference in gross margin</td>
<td>Control</td>
<td>11.36</td>
<td>33.43</td>
<td>33.16</td>
<td>21.28</td>
</tr>
<tr>
<td>Cost of treatment</td>
<td>0</td>
<td>9.48</td>
<td>5.5</td>
<td>14.98</td>
<td>9.28</td>
</tr>
<tr>
<td>Net benefit</td>
<td>0</td>
<td>1.88</td>
<td>27.93</td>
<td>18.18</td>
<td>12.00</td>
</tr>
</tbody>
</table>
The results in Table 6 show that under the price assumptions used there was a net benefit from all treatments. The yard weaning treatments showed the highest returns. To test the sensitivity of the results and allowing for price fluctuations it is estimated that the differences in gross margins should range under most price scenarios from $10 to $30 per head. The lower end results are most likely if it is proven that much of the improvement in growth rate was due to higher feed consumption.

Benefits to the industry of adopting a yard weaning strategy will depend on the adoption rate by producers. Adoption will in turn be determined by the quality of any extension program and the willingness of feedlots to acknowledge the value and negotiate a premium for yard weaned cattle. In order to attract producers to yard weaning, the costs must be matched by the premiums available. It is estimated that the cost of yard weaning is $5.50 comprising $5.00 per head feed (silage) costs and $0.50 in labour. At purchase weights averaging 290 kg, the premium required to cover costs is 1.9 cents. If vaccination is carried out in conjunction with yard weaning, the premium required to cover producer costs would be 5.2 c/kg. In reality an additional bonus is probably required to encourage producers to adopt a yard weaning strategy, unless other management advantages make the procedure worthwhile. Other advantages could include having quieter cattle, especially heifers, and having cattle that are trained for drought feeding should drought occur.

Feedlot capacity in Australia is currently 854,000 head (March 1997 Survey of Cattle in Feedlots conducted by ALFA and AMLC) of which 51% is currently utilised. Utilisation has increased from 40% to 50% from December 1996 to March 1997 and has the potential to increase still further if price prospects improve. Assuming an average feeding rate of 150 days on feed the current annual turn-off rate from accredited feedlots is 800,000. Table 7 on the next page provides estimates of the benefit that yard weaning technology could give to the industry given a range of numbers of yard-weaned cattle entering the feedlots per annum and a range of improvements in gross margins per head.

Adoption will take a considerable time to achieve. With adequate extension and feedlot incentives to producers a total of 400,000 yard-weaned cattle could be available to feedlots in by the year 2001. At an improvement in gross margin of $20 per head, this benefit to the industry would be $8 million dollars. As adoption increases the future gains would increase.
Table 7. Australian benefit per annum given number of cattle yard weaned and a range of improvements in gross margins.

<table>
<thead>
<tr>
<th>Numbers of yard-weaned animals in feedlots</th>
<th>$10</th>
<th>$15</th>
<th>$20</th>
<th>$25</th>
<th>$30</th>
</tr>
</thead>
<tbody>
<tr>
<td>200,000</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>400,000</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>600,000</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>800,000</td>
<td>8</td>
<td>12</td>
<td>16</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>1,000,000</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>1,200,000</td>
<td>12</td>
<td>18</td>
<td>24</td>
<td>30</td>
<td>36</td>
</tr>
</tbody>
</table>
Appendix 8 - Economic impact of pre-boosting strategies

Impact on Meat and Livestock Industry

The results reported here should impact most on the weaning and marketing practices of the Southern beef breeding sector of the industry. Yard weaning is not currently widely practiced and calves are often weaned directly into saleyards where they encounter considerable stress from mixing and handling. The fact that the feeder steer market is becoming an increasingly important outlet for these producers should encourage adoption of methods which have now been shown to improve the animals’ adaptability to feedlots. Yard weaning is a more integral part of the management of *Bos indicus* cattle in the Northern sector. However, this work has already stimulated similar trials being conducted by Drs Holroyd and Petherick in Queensland. In recent years, buyers of feedlot cattle have shown an increasing interest in the adaptive ability and disease-resistant qualities of genetically appropriate feeder steers that are also properly prepared and can be sourced directly from breeding or backgrounding properties. These findings should increase their resolve in this direction.

The principles on which these treatments were based will not be new to many people in the industry. It is apparent, however, that the industry has not yet been too successful at applying these principles in a consistent way in practice.

Two likely reasons for this is are offered below:

1. It requires the right combination of many small details to make an effective management practice and an overall quality assurance plan is essential.

2. The benefits of more effective pre-treatment of feeder steers were not clearly defined or recognised by all stakeholders, nor has there been an obvious economic incentive to improve this aspect of the beef supply chain.

This project, the practical application of which has already been described in a preliminary way by Fell et al (1997), has a direct bearing on both of these issues.

The findings should provide a useful guide to the combination of weaning and vaccination treatments which will be effective in many different industry situations. This is because such controlled trials help to reveal the underlying mechanisms and this provides a basis for extrapolating to other situations. It should also make the benefits of a weaning/vaccination package more visible and encourage the recognition and adoption of management procedures which add value at this point in the production chain.

However, the way in which this work is followed up will have a large bearing on its eventual impact in the industry. Much more industry experience will be required to validate these findings under a wide range of seasonal conditions, types of cattle and feedlot requirements and environments. We have only compared two basic methods of weaning (paddock and yard, with some variations). The effects of other methods
such as weaning in small paddocks with supplement, on-the-fence weaning, creep feeding before weaning etc. cannot necessarily be predicted from our work. Our results suggest, however, that other methods which do not have the intense socialisation benefit of yard weaning may not be as effective.

The Storelink project, initiated and managed by the MRC, provides an ideal opportunity to monitor the benefits and pitfalls of the many different variations of weaning practice that could be used in the industry. We believe that our results could be used both to guide practices developed in Storelink groups and to help in interpretation of the results that producers are obtaining within the project.

Finally, it is the contribution to the Australian Beef Eating Quality Assurance Program that will be the measure of the value of this work to the industry. There is good reason to believe that producing feeder steers which adapt better, remain healthy and grow well in the feedlot will play a useful part in assuring the quality of the product onto the consumer's plate. Integrating feeder steer management with the next stage of intensive feedlot finishing forms part of an emerging best practice for a quality trading alliance between steer suppliers, feedlotters and the beef-consuming public.

Conclusions

It was concluded that the method of weaning beef calves and whether or not they receive pre-feedlot vaccination against respiratory disease can certainly influence the subsequent health and weight gain of these animals in the feedlot. Clearly, a simple method of yard weaning which has been detailed here resulted in better weight gain and reduced incidence of respiratory disease than a fairly typical paddock weaning regime. It was also noted that additional training of calves to eat grain from a trough during weaning did not give a better result than simple yard weaning with hay or silage. A definite benefit in weight gain also resulted from the use of experimental vaccines 1-2 months prior to feedlot entry.

It was also concluded that these treatments would be cost-effective under a range of industry circumstances. Economic analysis showed that, in comparison to the gross margins for control animals, all treatments improved the gross margins per head when compared to the control. The best in terms of the highest improvement in gross margin were the yard-weakened, unvaccinated and the yard-weakened, vaccinated treatments where, using projected income levels and price levels, an improvement of $33 per head was achieved to the feedlot. Farmer costs of $5.50 per head for yard weaning alone or, perhaps $15 with vaccination, must be deducted from the feedlotter benefit because the feedloters would have to offer a premium of at least this much for the cattle to make it worthwhile.

Appendix 8 - Economic impact of pre-boosting strategies
The economic analysis also showed that, with adequate extension and a positive response from feedlot operators to offer premiums for producers to wean their cattle, a benefit to the industry of $8 million could be achieved by the year 2001.

Recommendations

In order to increase the likelihood of producing feeder steers which adapt well when introduced to the feedlot, are equipped to combat the infectious challenge and can therefore be expected to perform well in terms of health and weight gain, the following is recommended:

1. A method of weaning in small yards which has at least the major characteristics of the yard weaning procedure used in this project. These characteristics are listed below in what we believe to be their order of importance *.

2. The use of appropriate vaccines against respiratory disease (when these become commercially available) administered prior to feedlot entry to ensure that a protective immunity exists on arrival at the feedlot.

* Characteristics of the yard weaning procedure used in this project listed in what we believe to be their order of importance (the first four, however, being essential):

1. Well-built, weaner-proof yards with good quality water.
2. Pen stocking density of 4 m²/head for 180-260 kg calves.
3. Round bale feeder with good quality hay or silage ad libitum.
4. Kept in yards for 5-10 days.
5. Some human presence each day, but not for specific training.
6. Reasonably sloped, non-bog surface (e.g. shale or coal dust)
7. Solid opaque pen sides made from 1.2 m rubber belting