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Producing 20-month old beef steers off annual pasture

The feeding of hay has long been a traditional part of beef production in Western Australia. Is it becoming a luxury we can ill afford?

By K. D. Greathead, D. J. Barker and W. J. Ryan, Animal Production Division

A recent Mt Barker experiment compared two systems of fodder conservation with continuous grazing, using two types of steers, at three stocking rates. Year-round performance, carcass composition, and resulting costs and returns per hectare were assessed.

The most profitable system was conserving feed as standing fodder at the intermediate stocking rate. The cost of this system was low compared to conventional hay baling, but output per hectare was just as high. At the highest stocking rate conventional hay baling increased risk and decreased production per head and per hectare, compared to continuous grazing or standing conservation. The heavily stocked grade Hereford steers grew more than Friesian half-breds and attained a satisfactory level of fat cover for the table beef trade, while the Friesian crossbreds were under-finished.

All treatments at the intermediate and lowest stocking rates gave better results than the high stocking rate. Performance and fat cover of the steers on plots with standing conserved feed and baled hay were similar, and better than with continuous grazing. However at these lower stocking rates, the crossbreds outgrew the Herefords and both breeds reached satisfactory fat cover.

Production per hectare was greatest from crossbred steers at the intermediate stocking rate with either type of fodder conservation.

It has been traditional in West Australian beef production systems to conserve part of the "surplus" spring growth in the form of baled hay, for feeding back in autumn when paddock feed supplies are at their lowest. However, rises in costs of baling, storing and feeding hay have prompted investigation of cheaper alternatives.

This experiment by the Department of Agriculture measured the effects of alternatives to hay-making upon steer beef production—from weaning at eight months to slaughter at 20 months.

The experimental environment
The experiment ran from 1972 to 1975 inclusive at the Mt Barker Research Station. The long term average rainfall is 760 mm and the growing season generally extends from mid-April to mid-November. Ground frosts are uncommon and summer rainfall is almost never effective.

The soil types on the experimental area were mainly decomposing granites, with smaller areas having a greater gravel or clay content. The whole area was overlain by 25 to 50 mm of black organic material. Most of the site was a gentle slope facing west and the original vegetation had been jarrah and red gum.

The pastures had been established for many years and consisted of annual grasses (barley, winter and...
silver grasses), subterranean clovers (Woogenellup and Mt Barker) and weeds (capeweed and wild geranium) in roughly equal proportions.

In the year before beginning the experiment (1971) copper, zinc and molybdenum fertilisers were applied with the normal superphosphate top dressing of 220 to 250 kg per hectare annually. Five to one super/potash was applied to all plots in the third year of the experiment following suspicion of potash deficiency.

In the second year of the experiment, one-third of each plot was sprayed with Benlate after identification of clover scorch in areas conserved for baling. Steers to be used in the experiment were weaned at six to nine months of age in late November or early December each year. They generally weighed an average of about 250 kg and were in forward store condition (Score 2). Each animal was injected with anthelmintic for worm control and blackleg vaccine upon introduction to the experiment and the anthelmintic was repeated 14 days later and again at the break of the season. As each year’s draft went to slaughter they were immediately replaced on the plots by the next draft.

**TREATMENTS**

**Fodder conservation systems**

- Continuous grazing. In the continuous grazing system all steers on each plot had access to the whole plot all the time, and no fodder was conserved.
- Baled hay. In the baled hay system, one-third of each plot was closed up from early September until the hay was cut, baled and carried off in November. The following year’s draft of steers had access to the whole of each plot until it was closed up again the following September.

In the first three years, half the hay was budgeted to be fed back in the first month after break of season, one-third in the second month and one-sixth in the third month. In the last year the feeding budget was changed slightly to 18 equal feeds in the nine weeks following the break.

For the purposes of this experiment the break of season was defined either by the occurrence of 10 mm or more rainfall in a three day period after February, or the 1st April, or more than 10 kg per head liveweight loss in a 14 day period.

The hay made on each plot was stored separately, under cover, and was only fed back to the steers in the plot off which it had been made. In plots where insufficient hay was available to provide 6 kg per head at each of the 18 feeds, the rate was maintained at 6 kg per head, but the number of feeds was reduced. In those plots where more hay was made than the steers could eat, they were fed only as much as they would just clean up and the surplus was carried forward into the next year’s supply.

- Standing conservation. In the standing conservation system, one-third of each plot was closed up in early October. The steers were confined to the remaining two-thirds of the plot until slaughter, and the next year’s draft were confined to this area until mid-February when they were transferred to the one-third conserved. From the break of season until October they grazed over the whole plot area.

**Stocking rate**

The three fodder conservation systems above were compared at three stocking rates—2.5, 2.0 and 1.75 steers per hectare. Each of the nine stocking rate/fodder conservation combinations was repeated, giving a total of 18 small paddocks.

**Animals**

For each of the nine treatments there were 12 steers, grazed as two paddocks of six, each year. In addition 12 steers from each incoming draft were slaughtered to provide data from which the initial carcass weights and composition of the steers in the experiment could be calculated.

Each year two breed types were used (three in each plot). In the first three years the breed types used were Friesian x Angus and Friesian x Hereford but in the final year the Friesian x Herefords were replaced by grade Herefords.

**EFFECTS OF GRAZING MANAGEMENT TREATMENTS**

The results quoted below are the combined average for both crossbred types and the last three years of the experiment.

**Liveweight and carcass weight gain per head**

From Figure 1 it can be seen that the effects of fodder conservation depended on the stocking rate. At the highest stocking rate, the conventional baled hay treatment reduced production, but at the intermediate and low stocking rates its effect was favourable. However, production was just as good using the much cheaper standing conservation method. The minimum liveweight for the year was usually reached soon after the break of season in April. This liveweight varied with the treatments and indicated the possible risk of losses of animals in poorer condition. In general the risk was increased at the high stocking rate, especially with both fodder conservation treatments. On the other treatments the minimum autumn weight was within about 5 kg of liveweight at the start of the experiment, four months previously.

Most of the adverse effect of baling at the high stocking rate appeared to occur during summer and winter, thus increasing the risk of animal loss in autumn. However, most of its beneficial effect at the intermediate stocking rate occurred in summer and spring, and at the low stocking rate in autumn and winter. The standing conservation was beneficial mainly during summer and autumn at the intermediate stocking rate, and during autumn and winter at the low stocking rate again decreasing risk in both cases.
Part of the Mount Barker trial. The plot on the left shows the results of a high stocking rate plus the baled hay treatment, while the plot on the right shows the effect of a low stocking rate plus the nil conservation treatment.

Liveweight and carcass gain per hectare
Figure 2 shows that under continuous grazing, liveweight gain and carcass gain per hectare was highest at the high stocking rate, but when fodder was conserved, either baled or standing, the intermediate stocking rate produced more per hectare. The combination of conserved treatments and intermediate stocking rate, did in fact give the highest overall carcass gain per hectare.

Muscle gain
Muscle gain is of particular relevance to production of beef for markets demanding a very low fat content. Gain per head and per hectare was affected by treatments in a similar way to liveweight gain.

Fat cover
Figure 3 shows the effect of the treatments on the steers' degree of finish, as measured by carcass backfat thickness. The finish obtained generally corresponded to the liveweight gain per head in Figure 1. The small apparent differences within the low and intermediate stocking rates were probably due to chance.

In these results a backfat thickness of 7 mm to 9 mm between the 10th and 11th rib corresponds to condition score 3, which is the level at which carcasses give the highest percentage yields of retail cuts. However, processors often pay a higher price for animals in condition score 4 (10 mm to 14 mm).

While the actual levels of finish attained are affected by the liveweight gains made, they are also influenced by the initial weight and condition of the animals at weaning. Animals of lighter weight and poorer condition (score 1) than those used in the experiment would need to grow more to achieve the required finish at slaughter. Variation in average fat cover on the same treatment amongst different years showed a range of 2 mm. The baled conservation system gave least variation amongst different years.
EFFECTS OF BREED TYPES

Crossbred types

Overall the differences between the two crossbred types were small and inconsistent. In two of the first three years of the experiment, Friesian x Hereford weaners grew about 5 per cent more than Friesian x Angus weaners, but in the third year there was no significant difference between them.

When the Hereford crosses grew more, they had the same fat cover at slaughter as the Angus crosses, but when growth was similar the Angus crosses measured about 1 mm more backfat.

Crossbreds versus Herefords

At the intermediate and low stocking rate, under better nutritional conditions, the crossbreds produced about 16 per cent more than the Herefords in the third year of the experiment. However at the high stocking rate, under severely restricted feed conditions, the Herefords out-grew the crossbreds by 7 per cent.

For both breed types highest carcass gain per hectare was at the intermediate stocking rate using fodder conservation. On these treatments the crossbreds showed 5 per cent more carcass gain per hectare. At similar weights, the Herefords generally had about 1.5 mm more backfat cover than the crossbreds. However, since the crossbreds were heavier on this optimum treatment, the Herefords were less than 1 mm fatter at slaughter.

Time of turnoff

The earlier maturity of the straight-bred Herefords enables them to be turned off about one month earlier than the crossbreds. Table 1 shows the estimated three year average liveweight, carcass weight and backfat cover for both breed types that would be obtained if the animals were turned off earlier.

To estimate the average Hereford liveweight gain for all years, the ratio of Hereford performance to crossbred performance on appropriate treatments in 1975 was multiplied by the average performance of the crossbreds for all years of the experiment. The full liveweights consist of the gains to October, November or December plus the average starting weight of 250 kg.

The general relationships between liveweight and cold carcass weight, and between liveweight and backfat cover, were calculated from data in the experiment. These relationships are shown in Table 1.
relationships were used to estimate the average cold carcass weight and backfat cover of the different breed types in October and November. From Table 1 it can be seen that on average, the Herefords reach the same level of fatness about one month before the crossbreds and hence can be turned off one month earlier.

Using Herefords for earlier turn-off results in a lower carcass weight (7 per cent lower in November and 14 per cent lower in October) than the crossbreds in December. To achieve the same gross return, this lower carcass weight must be compensated by a corresponding increase in price per kilogram. Because of the wide variation amongst individual animals, the average backfat thickness can be misleading. To ensure 85 per cent of animals had more than 7 mm backfat cover it was found that an average of 8 mm or better was required. The remaining 15 per cent could be as low as 4 mm in this case.

It was found that in different years of the experiment the average backfat thickness from any one treatment showed a range of 2 mm. This suggests that for 85 per cent of the animals to exceed 7 mm backfat cover every year, the breed type average should be 9 mm. The Herefords achieved this in October, November and December, while the crossbreds achieved it only in November and December.

EFFECTS OF YEARS AND TREATMENTS ON FODDER AVAILABILITY

Seasonal variation during the four years of the experiment was high, and all four years received less rainfall than the long term average of 757 mm. Relative to the long term average, these years showed:
- 1972. Dry summer, normal break of season (early April), dry spring and early finish. Low total rainfall (505 mm).
- 1973. Dry summer, normal break of season, good spring rains and late finish. Nearly normal total rainfall (703 mm).
- 1974. Dry summer, false break of season in March, low spring rainfall, late finish, low total rainfall (575 mm).
- 1975. Dry summer, normal break of season, normal finish. Slightly below normal total rainfall (659 mm).

Hay yields

The effects of the grazing management treatments upon the steers in the first year of the experiment were not included in the results already discussed, because the amount of fodder available to these steers did not accurately reflect the grazing treatments since they were not applied in the preceding year.

After the experiment had been running for a year the stocking rate treatments showed marked effects on the amount of both conserved fodder and dry paddock residues available, while in the first year the differences had been much smaller. Figure 4 shows that the hay yields per hectare were considerably reduced at the highest stocking rate. Since the higher stocking rate also reduces the area of hay conserved for each animal, it further decreases the total amount of hay available per head.

At the high stocking rate all the baled hay available off the plots was fed back, and in the last year of the experiment a supplement of 16 kg of hay per head was supplied to avoid deaths. At the medium stocking rate a small surplus (172 kg average per year per grazed hectare) in excess of the animals' voluntary consumption, was accumulated through the four years.

At the low stocking rate a larger surplus (294 kg average per year per grazed hectare) was accumulated in the same way. These surpluses would be available for sale as extra output from these treatments.

Dry pasture residues

Soon after the new draft of animals was introduced each year, the amount of dry matter in the experimental paddocks was estimated by sampling. On the treatments which included standing conservation, the optimum stocking rate generally was that which made available to the animals about 1 000 to 1 200 kg of dry residue per head at this time.

Of this amount, about half was present in the conserved third of the paddock and the other half in the two-thirds being grazed at that time.

Pasture species composition

The major influence on pasture composition on the experimental area was autumn weather. A normal break of season produced a mixture in spring of about equal proportions of clover, grasses and weeds. However, after the false break in 1974, a dramatic increase in weeds and decrease in clover content occurred. The next year the original pasture species composition was restored after a normal break.

![Figure 4: Yield of hay (kg/ha) at three stocking rates in five years.](image-url)
Amongst the grazing treatments, baled hay conservation tended to decrease the grass content and increase the weed content of the pastures, especially at the high stocking rate. The high stocking rate treatment tended to increase both the weed and clover content of the pasture and decrease the grass component, and lower stocking rates increased grass content, especially under standing conservation. By the end of the four years of the experiment it was apparent that the pasture composition was generally stable in the treatments, but could vary in certain years.

**ECONOMICS**

Table 2 details the inputs and outputs for the optimum system and the changes in inputs and outputs which are obtained when the management system is altered. To use this information for an economic analysis local values should be entered under the optimum system. Costs and income can then be calculated for this system.

To calculate the economic change of an alteration in treatment the percentage change for that treatment is multiplied by the cost or income for the optimum system and entered in the appropriate boxes on the treatment row. Where no change has occurred a zero has been entered.

The calculation of the change in value of the carcass must consider the price per kilogram and the number of kilograms present. Fat cover determines the price per kilogram and any change in this must be multiplied by the total carcass weight and not just the gain. The new carcass weights have been entered under the cents/kg column. The change in price per kilogram is multiplied by this new carcass weight and the change in value due to price change is entered in the next box.

The percentage change in gain is multiplied by the income box from the optimum system to provide the change in value due to changes in gain. Where the change is less than 1 mm backfat in the treatment being analysed it has been assumed that the price per kilogram will not change. Zero has been entered in this box on the table. If the sum of all boxes in a treatment row is positive then under local conditions the particular treatment is more profitable than the optimum. If the sum is negative then the treatment is less profitable from the optimum. The safety margin in the table is the difference between the initial starting weight and the minimum winter weight and provides a good index of the risk of the various treatments. Negative values indicate greater risk.

Notable features of these results are:
- Stocking too heavily increases costs per hectare, decreases carcass weight gain per head and per hectare and also reduces the fat cover by 1 to 3 mm. It also considerably increases risk. These effects were greatest with conserved fodder treatments.
- Baling hay is costly and actually decreases output at the high stocking rate. At around the optimum stocking rate it increases output, but only as much as the cheaper conservation.
- The major difference among the treatment types was the extra fat cover of the Herefords compared to the crossbreds. This was achieved at the expense of about 5 per cent less carcass gain at the optimum stocking rate. Although at the high stocking rate and under standing conservation it was possible to finish the Herefords but not the crossbreds, the capital and operating costs were increased and carcass output per hectare fell using Herefords.
- At almost all likely levels of costs and value of outputs, the standing conservation system gives the most favourable outcome, especially at the medium stocking rate.

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**TABLE 2.** Economic analysis of steer management practices (per ha)

| Effect of increasing stocking rate 20% above the optimum (up to 2.46 Animals/ha) |
|-----------------------------|-----------|-----------|
| Change                     | -20%     | +20%     |
| Change                     | 0        | 0        |
| Change                     | -14%     | -5       |
| Change                     | 0        | 0        |
| Effect of decreasing stocking rate 14% below the optimum (down to 1.76 animals/ha) |
| Change                     | -14%     | -5       |
| Change                     | 0        | 0        |
| Effect of baling hay compared to the optimum |
| Change                     | 0        | 0        |
| Effect of no conservation compared to the optimum |
| Change                     | 0        | 0        |
| Effect of increasing stocking rate by 20% together with baling hay |
| Change                     | -20%     | +20%     |
| Change                     | 0        | 0        |
| Effect of decreasing stocking rate by 14% together with baling hay |
| Change                     | -14%     | +20%     |
| Change                     | 0        | 0        |
| Effect of baling hay compared to the optimum |
| Change                     | 0        | 0        |
| Effect of no conservation compared to the optimum |
| Change                     | 0        | 0        |
| Effect of increasing stocking rate by 20% together with no conservation |
| Change                     | -20%     | +20%     |
| Change                     | 0        | 0        |
| Effect of decreasing stocking rate by 14% together with no conservation |
| Change                     | -14%     | +20%     |
| Change                     | 0        | 0        |
| Effect of baling hay compared to the optimum |
| Change                     | 0        | 0        |
| Effect of no conservation compared to the optimum |
| Change                     | 0        | 0        |
| Effect of Hereford steers at the optimum |
| Change                     | 0        | 0        |
| Effect of Hereford steers together with stocking rate increase of 20% |
| Change                     | 0        | 0        |
| Effect of Hereford steers together with stocking rate decrease of 14% |
| Change                     | 0        | 0        |