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REPRODUCTION AND NUTRITION IN THE BEEF HERD

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I. INTRODUCTION

This paper is directed, in particular, at an examination of reproduction in relation to dietary energy and the efficient utilization of pasture. Improvements in nutrition will, in the main, result from a higher energy intake through the careful management of the beef herd on improved pastures adequately fenced and fertilized. Except for protein and phosphorus values no effort is made to cover the effect of specific nutritional deficiencies upon reproduction. These aspects have been well reviewed by McClure (1970, 1973).

History shows that the most highly productive pasture areas give the highest return when fattening store stock, thus the less productive areas are relegated to breeding. In other words, the majority of breeding properties are doing so because of their deficiencies which may be overcome by:-

(1) Use of selected breeds, strains and crosses adapted to the environment, e.g. the Zebu crosses in northern Australia.

(2) Pasture development with better pasture species to suit the environment, fencing, fertilizer and prudent stocking.

(3) Making the best use of available resources, i.e. to know and recognize -

  (a) seasonal nutritional peaks and inadequacies,

  (b) target weights, weight gains, and ages necessary for high animal performance, and

  (c) phases in animal growth and the reproductive cycle when nutritional requirements are most critical.

With cognisance of the above factors it is then necessary to adjust stocking rate so as to have available and channel the feed where it can be used to the best advantage.

II. OBJECTIVES

On highly improved properties the following can be accomplished:-

(1) Heifers joined at 14 months of age after having reached puberty; they should weigh no less than 190 kg, when weaned at six months of age. At joining, the heifers must weigh no less than 275 kg and 295 kg for Angus and Herefords respectively. Breeds of larger mature size will need to be joined at heavier weights. No less than 0.45 kg/day should be gained from six weeks prior to and during the joining period.

(2) Lactating females commence cycling sufficiently early to be pregnant within 80 days post-partum.

(3) Low calf wastage.

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III. MANAGEMENT : BIRTH TO FIRST MATING

Yearling joining results in increased genetic improvement, early culling of less productive animals, increased total lifetime production, and assists in selection of high milk production. Pinney et al. (1962a) found that beef females calving first at two years of age produced almost 0.8 more calf per cow over their entire production life at 10% less cost when compared with those calving first at three years of age.

Pre-weaning and post-weaning growth rates must be high to reach the necessary target weights. Using varied planes of nutrition, Sorensen et al. (1959) were among the first to show that heifers reached puberty at nearly constant weights but at widely differing ages, according to their TDN intake. Later, Wiltbank et al. (1966) used Hereford and Angus heifers weaned at 200 days of age to examine feeding levels in relation to age and weight at puberty. Heifers were fed to gain 0.2 kg/day during the five-month winter feeding period (low level) or 0.4 kg/day over 196 days (high level). On the low level, variation in average daily gain from weaning to 396 days of age was more important than variation in pre-weaning gains in its effect on the occurrence of puberty. However, pre-weaning average daily gain had a significant effect on the occurrence of puberty at the high wintering feed level. Table 1 shows that as feed level increases, age at puberty decreases and weight at puberty increases.

TABLE 1

Age and weight at puberty in relation to nutrition

	Low winter level			High winter level		
Puberty	No.	Age (days)	Wt (kg)	No.	Age (days)	Wt (kg)
Hereford	26	457	269	26	413	306
Angus	29	396	233	25	337	251

After Wiltbank et al. (1966).

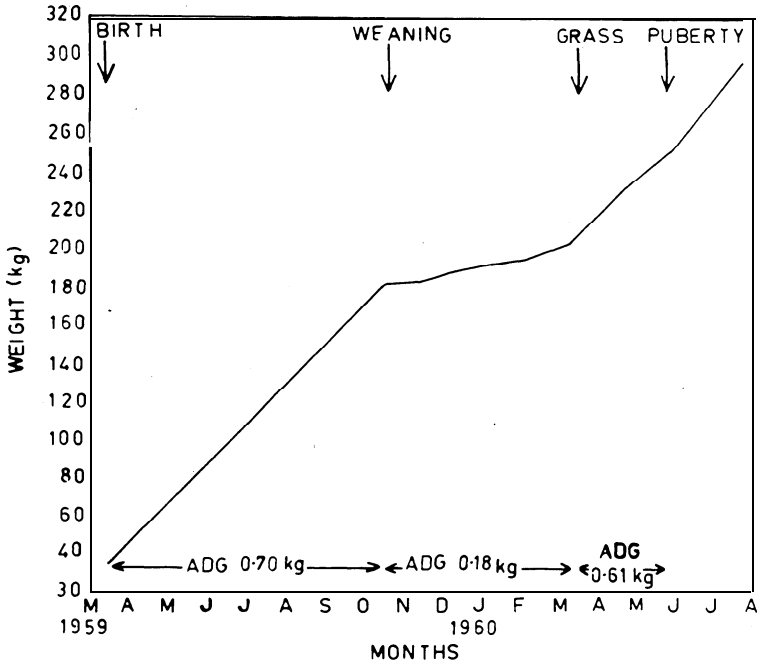
Menge et al. (1960) showed with Friesians that age at puberty decreased 0.77 days and 0.36 days respectively for each additional 0.45 kg weight at 6 months and gain in weight between 6 and 12 months of age. Thus weight at 6 months played an important role in the initiation of early puberty.

A study on the joining of low weight Hereford and Angus heifers joined at 15 months of age showed that heifers gaining 0.49 kg/day during the joining period failed to conceive until the mean weight reached approximately 270 kg (Young 1973). In South Australia, Ellis (1970) reported that Hereford heifers joined at 270 kg produced 80% calf drop following a 10-12 week joining period and reductions of only 27 kg caused a 20% lower calf drop. 'Weight change was not reported.

The first serious check in the calf's growth rate is likely to result from weaning. (As an example of a common experience, the findings of Arije and Wiltbank (1971) are presented in Figure 1).

Tulloh (1963) found that weaning at 9 months of age in autumn resulted in a severe depression of growth rate. If yearling joining is to be effective, this post-weaning growth check is to be avoided. The younger an animal is at weaning, the greater the growth check is likely to be and the longer is the period of recovery on ad lib. realimentation. Under grazing conditions in New Zealand there was a close relationship between liveweight gain and milk production up to 12 weeks of age, and thereafter the correlation was not

FIG1 AGE AND WEIGHT AT PUBERTY



AFTER ARIJE & WILTBANK(1971)

significant (Walker 1963). On the basis of this information, early weaning was recommended - three to four months of age. Since that report, further trials in New Zealand have clearly shown the substantial limitations to compensatory growth following a post-weaning growth check (Joblin 1969; Scales and Lewis 1971).

Under circumstances of feed shortage of frank drought conditions, early weaning is justified and desirable. In less severe conditions some graziers in Victoria find creep feeding a rewarding practice..

For yearling joining, at least 50% of heifers must reach the target weights outlined above. This will allow for a 20% replacement rate with approximately 20% of the weight-selected heifers culled for other reasons, e.g. pelvic development. Excessive fatness can be detrimental to milk production and lifetime reproduction. In large herds it may be necessary to grade heifers to restrict a few and perhaps give others priority feeding; even the heavier heifers should be gaining at the rate of 0.45 kg/day from six weeks prior to joining.

IV. MANAGEMENT : FIRST TO SECOND MATING

The joining period for heifers is to be limited to two months and non-pregnant heifers culled on pregnancy diagnosis. A two-month joining limits the period of surveillance at calving and assists control of the energy intake perinatally. Late-calving heifers in a spring-calving situation in New South Wales have shown significantly higher calf birth weights. Joining heifers a month before the main herd and for a shorter time also ensures that the slow-to-ovulate first-lactation cow will be cycling when joined with the main breeding herd.

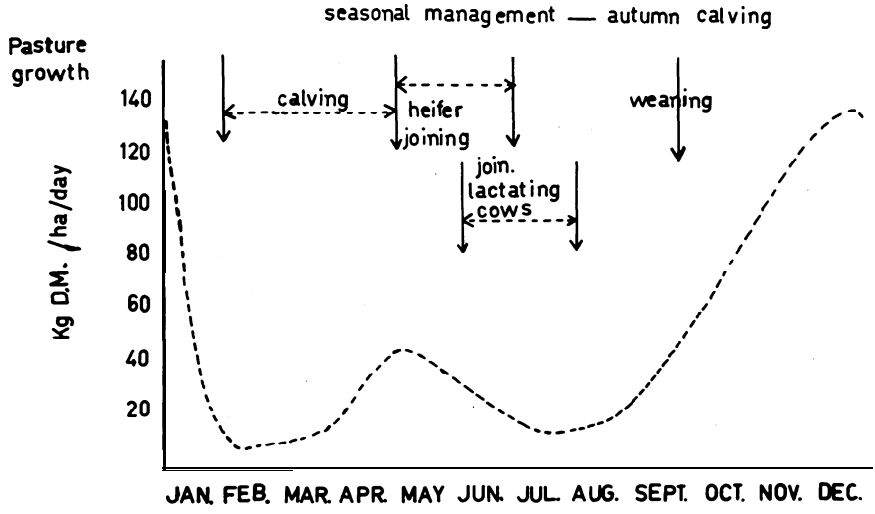
Heifers joined at target weights outlined above should weigh 340-370 kg at the 5-6 month stage of gestation. At any stage of pregnancy excessive fatness is undesirable. During the last 3-4 months of gestation the heifer should be held at maintenance or below, when she will be gaining 40 kg-55 kg from foetal and uterine development. Calf birth weight accounts for 57-59% of the weight loss at parturition (Ewing et al. 1966).

The most common cause of dystokia among heifers is foeto-pelvic disproportion. Many reports have indicated that restricting intake in late gestation will reduce birth weight (Young 1970) and thus reduce the incidence of dystokia from foetal oversize. Heifers held at maintenance or below will exercise more frequently than well-fed or overfed heifers and increased muscle tone is a likely consequence. On the other hand, extreme restriction, as occurs in severe drought, can cause dystokia through pelvic ligaments and tissues failing to relax and dilate the posterior pelvic canal.

It has been shown that beef heifers restricted during the last three months of gestation and amply fed post-partum can return a high level of fertility at their next joining (Dunn et al. 1969). Field trials with Angus heifers calving at two years of age have confirmed these findings, in that provided heifers calved early and were well fed on pasture post-partum, there was no depression of fertility at their next joining (Young 1970).

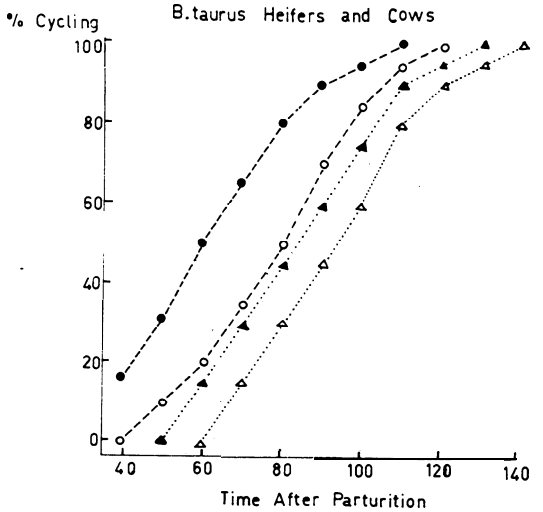
Under practical grazing conditions weighing will be necessary to show the animal's nutritional status. It may be that weight loss in late gestation is a normal occurrence on some properties, e.g. it can be expected under autumn-calving conditions in Victoria (Fig. 2).

FIG.2. Pasture production in relation to breeding herd



Both breed and age also affect time of ovulation when nutritional levels are believed to be adequate (Fig. 3 from Alexander and Williams 1973).

Fig. 3. Cumulative Distribution of the Length of Post-partum Anoestrus in B.indicus and B.taurus Heifers and Cows

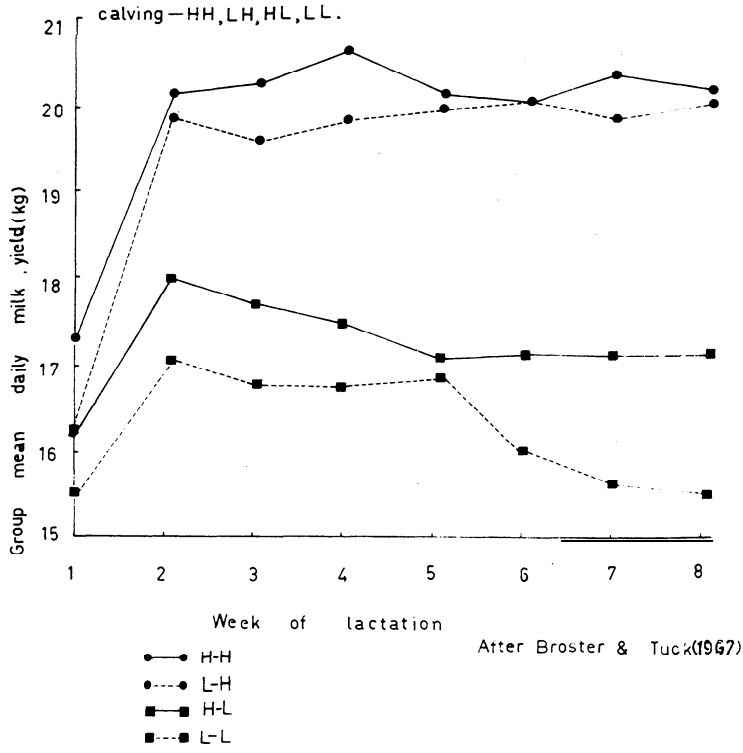


Milk production and hence calf growth rate is the other important factor likely to be affected by energy restriction in late gestation. In this regard there is little information available on cattle. The most intensive work on the effect of pre- and post-partum nutritional levels has been done on sows and ewes where it has been shown that nutrition during pregnancy has little effect on milk yield if post-partum energy levels are adequate (Young 1970).

Over a period of three years Campbell and Flux (1948) examined butterfat production of Jersey cows that were restricted or fed ad lib. during the last 10 weeks of gestation. Restricted animals showed a 4.1 kg mean weight loss, while the ad lib. group maintained or gained weight pre-partum. Subsequent butterfat production favoured those well fed in late gestation, but the differences were small.

Broster and Tuck (1967) subjected Friesian heifers to low plane and high plane nutritional levels for the last 6 months of pregnancy. Heifers from each group were paired at random to high and low planes post-partum. Using early post-partum weight as a comparison, the high plane and low plane gained 0.40 kg/day and 0.22 kg/day respectively over the last 6 months of gestation. Reference to Figure 4 shows the small difference in milk production between the high-high and low-high groups in early lactation.

FIG.4. Mean daily milk yield of four groups of heifers fed at two levels before(H & L) and after(H & L) calving—HH, LH, HL, LL.



After Broster & Tuck(1967)

There is an increased efficiency of food conversion when animals are realimentated after restriction (Wilson and Osbourn 1960) but the increased growth rate is, in the main, due to a significant increase in appetite. This conclusion has been questioned by Meyer and Clawson (1964). They found that about 52% of an ad lib. diet in sheep (and rats) maintained body weight, body fat and protein percentage.

V. MANAGEMENT : SECOND TO SUBSEQUENT MATINGS

Between 5 and 7 years of age the beef cow is at her production peak in respect to high fertility, high milk production and lowered sensitivity to nutritional changes. Above and below these ages selective attention is necessary, particularly in large herds where competition is high.

On hill country in New Zealand, Hight (1966) reduced mature cow liveweight by 18% over the last four months of gestation. At the time of restriction, these Angus cows averaged 410 kg. Another group of cows of similar age was kept on a high plane in late gestation. From calving to weaning the liveweight increase of the low-plane cows was about three times that of the high-plane group and following a 12-week joining period there was no difference in pregnancy level between the two groups. This extreme loss of liveweight in late gestation was regarded as the limit that such cows could withstand.

Hight (1968a) later varied the post-partum nutritional levels under grazing conditions with mature Angus cows. Once again the degree of deprivation in late pregnancy was extreme. The proportion of cows non-pregnant following a 12-week joining period was 9.1%, 9.1%, 3.1% and 44.8% for the high-high, high-low, low-high and low-low groups respectively. The age-adjusted weaning weights of the calves from the first three groups were 34 kg, 20 kg and 20 kg heavier than the low-low group. Under less severe deprivation in late pregnancy the weaning weights did not differ (Hight 1968b). Pre-calving plane of nutrition had no effect on the performance the following year, but there were carry-over effects due to the differences in the post-calving plane of nutrition imposed during the previous suckling period.

Pinney et al. (1962b) found losses of 10-15% tolerable in late gestation. Obviously the tolerated weight loss will depend upon initial weight, but 10% can be regarded as safe with adequate feeding post-partum.

VI. NUTRITION AND REPRODUCTION IN THE MALE

Nutritional effects on bull fertility parallel the situation with the female. In young bulls puberty is related to body weight and energy intake and well-grown bulls can be used at 14 months of age. As with the female, continuous over-feeding can lower reproductive performance. As it takes 50 days for a sperm cell to develop, mature and appear in ejaculate, bulls must be fed adequate energy rations at least 2 months prior to joining. The replenishment rate following successive ejaculations is lower in young bulls (Van Demark and Maugher 1959), hence young bulls may need spelling after 3 weeks use.

VII. REPRODUCTIVE ASPECTS OF NITROGEN AND PHOSPHORUS DEFICIENCIES

The widespread occurrence of phosphorus deficiency in the north and coastal areas of Australia justifies an examination of the likely consequences. To quote from Little (1970), "The initial and basic effect of phosphorus deficiency is a depression of feed intake. Responses to phosphorus supplementation in the field are invariably confounded by and indistinguishable from those due to concomitant increases in intake". Deficiencies of phosphorus become most serious in drought times with deterioration in pasture quality, as is the case with protein deficiency. In fact, the two deficiencies tend to occur together and available evidence indicates that both should be supplemented during prolonged dry periods. Ritson et al. (1971) produced some evidence that superphosphate had a direct effect on conception rate independent of liveweight change.

Andrews (1972) reported increased reproductive rates in the north with the use of better pasture legumes and with direct supplementation. It is noteworthy that the Brahman and their crosses have a better weight gain on low protein pastures than their British counterparts. Field evidence on the use of urea supplements has at times been inconclusive, although Winks et al. (1970) recorded higher weight gains in weaners fed urea-molasses as compared with molasses feeding alone. (Norman (1965) found that liveweight gains ceased when the nitrogen content of the pastures fell below 0.4%). As with phosphorus, a low protein level in the ration reduces the intake of feed and hence indirectly influences the energy intake (Wiltbank et al. 1966).

VIII. FEED UTILIZATION

"Choose the best males to the best females and keep them in a thriving state." In these terms Bakewell summed up his cattle breeding objectives (Francis 1970). In retrospect, Bakewell's observations on the importance of

the animal environment have been put to great economic advantage by stud breeders.

In viewing the current trend to elephantine breeds and strains it is well to remember the growth pattern of cattle as outlined by Cartwright (1970):-

(1) Rate of gain during any given stage of maturity is genetically positively correlated with mature size.

(2) Age at which a given stage of maturity is reached tends to increase proportionally as mature size increases.

(3) Maintenance requirements are proportional to size at all ages: hence large cattle have greater requirements than smaller cattle.

Taylor (1970), quoted by Tulloh (1972), has suggested that, after minor adjustments for differences in mature size, percentage growth rate may give a better indirect assessment of efficiency of production than either absolute growth rate or 400-day weight (Table 2).

TABLE 2

Figures from British M.L.C. beef recording scheme

Breed	Liveweight (kg) at 400 days	Growth rate 200-400 days	
		Gain/day (kg)	% growth rate/day
Charolais	514	1.18	0.30
Angus	420	1.07	0.35

Most work has indicated that animals that are more efficient feed converters acquire this greater efficiency through a greater feed intake relative to maintenance needs. Blaxter (1971), discussing feed usage, has concluded that "Animals are equally efficient at converting feed if they achieve the same levels of feeding relative to their maintenance requirements" and "with young animals that grow rapidly, the more feed an animal consumes the more efficient it is at converting feed to body weight gain".

Animals that gain more in times of plenty may be less efficient animals in a weight-loss situation - a frequently recurring Australian pattern. The specific adaptation of cattle to tropical conditions should not be overlooked. In a number of circumstances genetic factors which reduce stress may affect feed utilization. Thus the tick-resistant Zebu crosses are relatively tolerant of poor nutritional conditions, while under hot conditions they can make better use of a plentiful supply of feed. Brahmans and their crossbreds have a lower maintenance requirement (Vercoe 1970) but voluntary intake tends to be low (Frisch and Vercoe 1969). Nevertheless, the voluntary intake of both Brahman and Africander cattle was significantly correlated with liveweight.

It becomes apparent that the expression of superiority of the breeds and strains which are currently favoured is dependent upon increased feed intake and reproductive performance will suffer unless due allowance is made. This means that adequate feed must be available and it is likely that animals regarded as superior will be more sensitive to periods of deprivation.

IX. DISCUSSION

The objectives outlined earlier are not beyond the scope of well-managed, highly-improved properties. In order that each property unit can assess its own suitability for the adoption or continuation of these aims a

set of scales and individual field identification of animals are necessary.

Particular attention has been directed to the growth and management of young cattle as this is believed to be the key to successful herd management. If the target weaning and joining weights are not attained with relative ease, it may be wise to accept a lower standard and join heifers at two years of age. Joining a month or more before the main herd is then no problem, joining weights can be lower, and the suggested nutritional regimes are easier to implement.

Efficient property management is an integration of animal requirements and feed availability. The use of cattle selected for high growth rate and large mature size will increase animal requirements and hence the need for extra feed. The type of assessment required for each unit is illustrated in Figure 2 which shows pasture production in relation to animal management with autumn calving, which is examined thus because it is a common practice in the winter rainfall areas of Victoria. Calving time is appropriate following the end of the period of lowest pasture production, because heifers should not be gaining in late gestation and some weight loss in mature pregnant cows is of little significance. However, for high fertility and high milk production, pasture availability is too low so that it will be necessary to supplement the lactating cows - particularly the first lactation cows. If autumn-saved pasture is not available, the cheapest supplement would be silage conserved from the spring pasture peak but green crops, grains or legume hay are most commonly used. One of the great advantages of the system comes at weaning as calves can take full advantage of the excess feed available, avoid the post-weaning growth check and reach target joining weights at an early age - in fact, sometimes too early and tend to fatten. The onset of autumn rain will usually result in heifers gaining weight before joining, but some supplement may be necessary during joining.

When the pasture-growth pattern in Figure 2 is related to a spring-calving situation, different problems arise. Thus calving comes close to the time of maximum pasture production. Heifers may need restricting in late gestation and/or calving advanced to late winter as a property responds to improved pasture and fertilizer. Mature cows should not lose more than 10% of their weight over the winter but the period of post-partum supplementing is likely to be short except for the early-calving first-lactation cows. The greatest problem arises with a severe post-weaning growth check after April-May when weaner heifers will require autumn-saved pasture or other supplement to maintain continuous high growth rates necessary to reach the target joining weight. On the other hand, the gain per day at joining for both heifers and lactating cows should be satisfactory. Each property should examine its management practices in relation to pasture production and fodder conservation.

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