THE EFFECT OF LEVEL OF NUTRITION ON THE SEXUAL CAPACITY OF DAIRY BULLS

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Providing a cheap yet complete ration to ensure maximum growth and production in domestic animals has been one of the chief concerns of the animal husbandman. In addition to the requirements for growth and production the needs of the pregnant female have been closely studied. It is natural that more emphasis has been placed on the female animal, as she bears the greatest reproductive load and takes the greatest risks in the physiological process of animal life that we use to our advantage. The male domestic animal, on the other hand, takes no risks, and in New Zealand, apart from a short breeding period each year, is regarded as a first-class nuisance. As for the dairy bull, his only value, that of transmitting female qualities, remains unknown until announced posthumously, or so late in his reproductive life that little use can be made of it. It is only in cases of impending sterility or the distinction of becoming a "Merit Sire" that interest in the stimulation or preservation of male attributes assumes any importance.

The interest that has been shown in late years in artificial breeding in dairy cattle, the short breeding season for dairy cattle in New Zealand, and the rarity of the bull proven at the 400lb. level, have forced us to consider ways of recovering the utmost from our bulls in a short time, and in exploring methods of feeding and handling which may increase their usefulness. In this connection, many components of cattle foods have been examined by overseas workers to determine their influence on the fertility of the dairy bull. Claims that certain foods or specific substances such as proteins have the desired effect of stimulating spermatogenesis have sometimes been made on slender evidence, and in some instances conclusions which appeared reasonable from work conducted with one animal have been applied unjustifiably to quite different animal species.

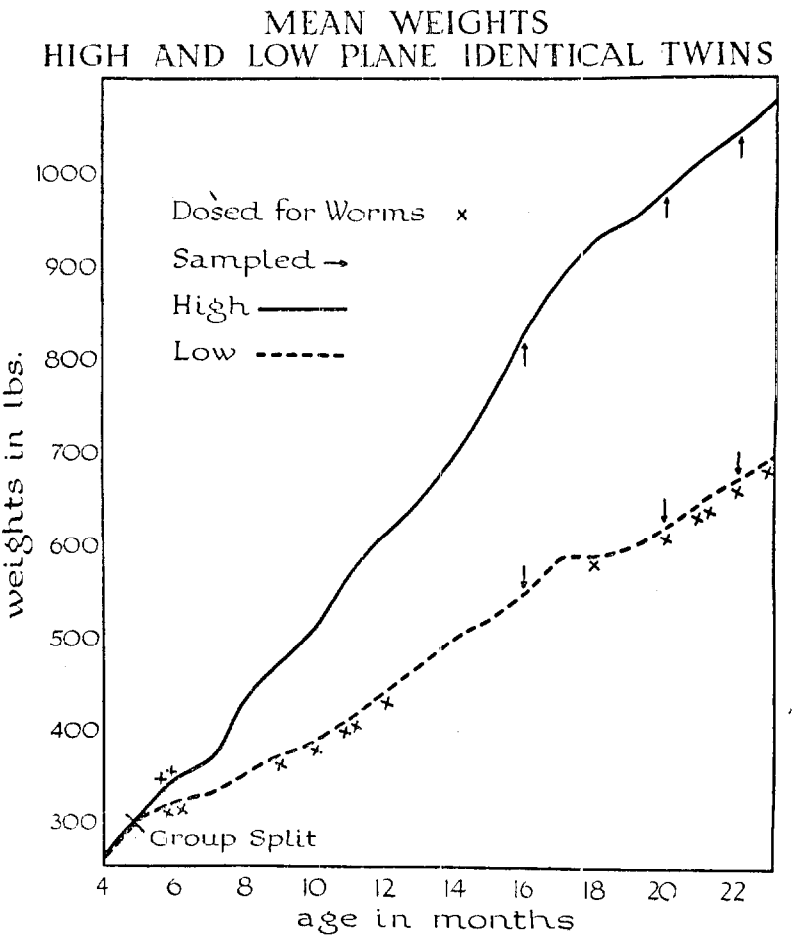
Work on reproduction in large farm animals is costly owing to the time taken to complete reproductive cycles, and the feeding and handling of them over long periods. The use of identical twin bulls provides a practical way out of many of the difficulties connected with large animal experiments. Such bulls have been used at Ruakura for assessing the effect of some of the factors which are likely to influence the sexual performance of dairy bulls.

The part of these studies which is being described in this paper deals with the effect of widely differing levels of feeding on the sexual capacity of dairy bulls up to two years of age. Some earlier work with similar animals showed that when rations were fed, differing widely in their protein content, but closely balanced in energy value, no effect in sexual capacity was observed with varying quality or quantity of the protein ration involved. In these particular experiments the nutritive ratios varied from 1:11 for the control group to 1:1.15 for the high protein group. Animal protein in the form of meatmeal was included in one trial. The object of the experiment now being described was to test the effect of two widely divergent levels of feeding, resulting in considerable body-weight differences, on the sexual ability of bulls during their first two years of life. If real differences were shown with this treatment it was planned to place the low-plane group on the treatment given the high plane bulls after two years. This would show whether body weight and semen production could be equalised by good feeding after two years of poor treatment.

Five pairs of identical twin bulls were selected for this experiment. They were divided into two groups at weaning when the bulls were 20 weeks old and weighed on the average 306lb. The subsequent treatment of the high plane group can best be described as being similar to that given stud bulls being prepared for sale. They were moved frequently on the rotational grazing principle, they had access to hay at all times, and supplementary feeding was carried out whenever shortages of pasture warranted it. The aim in this group was to provide a good rate of growth with pasture as the main food. The concentrate mixture consisted of lucerne chaff 45 parts, crushed oats 30, linseed-meal 15 and bran 10 parts. This was given at the rate of 3 to 4lb. daily. During the winter this group was covered.

The low-plane group were kept as short of grass as was possible to ensure the poorest development compatable with life. They were subjected to rigid set-stock treatment with poor hay as the only supplementary food. When a low-plane animal started scouring badly or became too low in condition to make his survival a reasonable risk, he

Diagram 1.



was placed on the high plane treatment until he recovered. In this group frequent drenching against parasitic worms and coccidia was necessary.

The rate of body-weight gain for the two groups can be seen from diagram 1. Times of semen sampling are marked, and the occasion that drenching was necessary for the whole groups. There were four test samplings at approximately three-monthly intervals. At the first test the mean weights differed by 270lb., and by two years this had increased to 437lb. The range at the first test varied from 216lb. for twins 11 and 12 to 373lb. for twins 27 and 28, and the same pairs showed the least and greatest differences at the final test when they differed by 387lb. (11 and 12) and 514lb. (27 and 28).

At this stage there was a very marked difference in the sexual development of the two groups of bulls: The high plane animals showing well developed male heads and crests, the low plane being devoid of any such character in their appearance.

The low plane twins would be considered constitutionally weak though their high plane mates look excellent in this respect. Bull 8 on the high plane showed an aggressive nature early in life. His twin 7 was not noticeably aggressive until he was placed on the high plane feeding at two years of age, when he quickly became aggressive, too. Bulls 21 and 22 were unthrifty from early life, and even on the high plane feeding level bull 22 had to be nursed along several times.

From 15 months until 24 months four tests were made on the sexual capacity of the two groups. The tests consisted of exhaustion runs in which each bull was offered ten services at 15-minute intervals, the total sperm production being taken as the measure of the bull's capacity for work at that time. In these trials there was a marked advantage in sperm production to the high plane group. These bulls consistently over produced their low-plane mates in every test. The following table summarises the results from each group:—

TABLE I.

Mean Body-weight and Sperm Production from Low and High-plane Bulls.

	Low-plane Group		High-plane Group	
Test	Mean weight Lb.	Mean sperm production X10^9	Mean weight Lb.	Mean sperm Production X10^9
1	573	9.2	843	16.2
2	601	10.7	976	19.0
3	692	11.5	1052	25.6
4	683	13.3	1120	23.0

Expressing the differences in body-weight and sperm production as percentages, the figures for the four tests would read as follows in Table II.:—

TABLE II.

Sperm Production and Body-weight in Low-plane Bulls Shown as a Percentage of the High-plane Bulls.

Test	Sperm Production	Body-weight
1	56.8	68.0
2	55.9	61.6
3	45.0	65.8
4	57.8	61.0

Testicular measurements were taken during the experiment, and an attempt has been made to calculate testicular volume from them, to see whether there were very marked advantages to the high plane group and whether these parallelled the body weight percentage differences. The measurements suggested that per cent. differences in testicular volume amounted to 71.5 per cent. at the time of the first test, and 63.5 per cent. for the last test.

As well as a distinct advantage in volume to the high plane bulls there was also a marked improvement in sperm density in their samples.

In considering the sperm collections from two groups of bulls such as these, we have to take into account the possible effect of a very poor level of feeding on the sexual drive of the animals involved. Semen collections as we take them from bulls are undoubtedly voluntary contributions, and the samples produced are the sum of two quite different processes, the ability to produce sperms by the seminiferous tissue and the desire to serve. Completely sterile bulls are often very keen and vigorous servers, and frequently bulls which have ample ability to produce sperms have very little inclination to mount a cow even at the height of the heat period. In these tests on sperm production with the high and low plane bulls, very low condition may have depressed the sexual drive so that we were measuring a reduced sex drive rather than a capacity of the sperm forming tissue to produce sperms. In this experiment there was little difference in the sex urge in the two groups in the first two exhaustion tests, but in the last two there was some tiring on the part of the low plane group, though they were so poor at this stage that the physical effort of serving was having an effect. In general the serving behaviour of a bull does not seem to be related to his condition, but is a characteristic of that bull or pair of bulls in an identical twin pair. Slow serving bulls or bulls which only serve five or six times instead of ten as required by the exhaustion test, have these faults as part of their inherited behaviour patterns and it is little altered by quite drastic experimental interferences.

There was no deterioration in the sperm morphology of the bulls on the low feeding level, and there is nothing to suggest that those animals, poor as they were, could not have got a few cows in calf. The capacity for work rather than the fertility was affected by the treatment, and one of the most interesting features of the work is the surprising level of sperm production, and the development and retention of sexual drive under very unfavourable circumstances.

The question naturally follows: Will the poorly reared animals catch up to their twins in body weight and sperm production when they are placed on better feeding? This part of the experiment has not been completed, but the indications are that sperm production will be equalised before body weight is made up. In fact, it looks as though some of the low plane animals may lack sufficient frame to equal the weight of the high plane bulls.

It may be asked whether this work has any practical significance, as farmers are unlikely to bring their bulls into service in the condition described for the low plane group. Though this must be admitted, cases are sometimes encountered where young bulls are in very poor condition approaching the breeding season. Those who make a business of selling young bulls usually make some effort to have them in robust condition at the time of the annual sale. It is a fortunate circumstance that the period of maximum pasture growth coincides with the period of greatest use of dairy bulls in New Zealand.

The question of the effect of excessive fatness on the sexual performance of bulls has not been considered in this paper. This is constantly brought up by farmers as a source of reduced sexual efficiency, it is planned to examine that aspect of the problem when the low plane experiment is completed.

Only a few of the possible nutritional factors which might affect reproductive efficiency have been examined so far in this work. Vitamin A has been implicated in infertility in special circumstances. It is possible it may occur in New Zealand, and it will have to be examined. Emphasis is also being redirected on the role of Calcium and Phosphorus in sterility and as time permits these interesting possibilities will be tested with identical twin bulls. A brief reflection on the seasonal nature of our dairy farming which concentrates most of the breeding into the early summer does not suggest Vitamin shortages among bulls as a serious source of bull infertility. The almost exclusive use of pasture also tends to exclude Calcium/Phosphorus inbalances, for if that were important bull infertility would be very much more serious than it is at present. The work so far done with identical twin bulls suggests that environmental factors, excluding disease, have to be extreme before they effect sexual capacity. Such extreme treatment is not likely to occur under accepted standards of husbandry.

Discussion on Mr. James's Paper

Prof. CAMPBELL: Could any differences be detected on palpation of the testes?

Mr. JAMES: No, there was no detectable differences in the "tone" of the testes. Such differences are much more marked in rams than in bulls. A difference in size, however, was noted.