

## **USMARC twinner bloodlines - ultrasound pregnancy diagnosis and twins.**

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### **Introduction**

Beef production is relatively inefficient and greenhouse gas intensive, primarily due to the high cost of maintaining the cow. This could be improved by higher fecundity. An intensive genetic selection program for twinning over approximately 30 years in a composite herd at the US Meat Animal Research Centre (USMARC) in Nebraska has developed a line of cattle with the potential for a twinning rate of up to 60%. I have reviewed this program <sup>1</sup> and in 2004 arranged to import some embryos from this line. Since then several other importations of semen and embryos have been made from this source. These are being used to grade up our commercial beef herd over time.

### **Methods**

Ivanhoe has a small commercial herd with between 18 and 99 breeders with at least 50% twinner blood exposed for mating each year. This paper is reporting on these results. Mating, mostly by natural service but with some AI (using a standard cidriol +CIDR+PG program) starts in June each year with calving in March, April and into May. Ultrasound pregnancy diagnosis under farm conditions, using a hand held 5 MHz linear array probe (Pye medical 485 Anser) is carried out soon after the bulls come out. This pregnancy testing has been carried out an average of 11 weeks after the bulls went in ( usually in August, range between years, 6 - 13 weeks). The literature suggests that the best accuracy of detection of twin pregnancies is between 6 and 12 weeks of gestation<sup>5,6</sup> however under commercial constraints it is difficult to achieve this for all cows in the herd. In later years a manual rectal examination in January has been used to confirm ongoing pregnancy. Calving is closely supervised.

### **Results**

During the period 2007 to 2014, 56 cows have remained in the herd for at least calvings at 2, 3 and 4 years of age. Over this period, 29% have had no twins, 48% have had one set of twins and 23% have had 2 sets of twins.

A more detailed examination of the results from this herd shows the conception rates based on the end of first trimester ultrasound pregnancy examination (Table 1) and calves born (Table 2) of these USMARC twinner blood (50% or better) cattle.

Table 1. Number of foetuses recorded at Ultrasound examination in first trimester by age of cow at mating.

Conception rate (no of foetuses)	15 months	27 months	older	Total

0	22.6%	19.1%	13.4%	17.9%
1	54.7%	29.6%	40.8%	42.7%
2	22.0%	50.4%	44.3%	38.3%
3	0.6%	0.9%	1.5%	1.1%
No of Cows	159	115	201	475

Table 2. Number of calves born per cow mated, by age of cow at mating.

No of calves born	15 months	27 months	older	total
0	33.1%	39.1%	29.2%	33.0%
1	52.2%	34.5%	41.7%	43.9%
2	14.7%	25.3%	27.8%	23.3%
3	0%	1.1%	1.4%	0.8%
No of cows	136	87	144	367

Table 3a. Pregnancy outcome for cows diagnosed by ultrasound with a single pregnancy in early pregnancy (August pregnancy test).

January Pregnancy test	Calving outcome	
Empty	0	3.5%
Pregnant	0	5.5%
Pregnant	1	86.8%
Pregnant	2	4.2%
Total number of cows		144

Table 3b. Pregnancy outcome for cows diagnosed by ultrasound with a twin pregnancy in early pregnancy (August pregnancy test).

January Pregnancy test	Calving outcome	
Empty	0	21.9%
Pregnant	0	6.3%
Pregnant	1	16.4%
Pregnant	2	53.1%
Pregnant	3	2.3%

Total number of cows	128
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The two times for pregnancy testing (in early pregnancy {August} to count foetuses, and in late pregnancy {January} to confirm ongoing pregnancy status to assist in calving management) allowed an estimation of the effect of conception rate on the time of pregnancy loss (Tables 3a and 3b). For those cows and heifers initially diagnosed with one calf, 3.5% lost calves in mid pregnancy and 5.5% lost them in late pregnancy. For those initially diagnosed with twins, 22% suffered a total loss in mid pregnancy and 6% had a loss in late pregnancy and a further 16% suffered a partial loss at some time during pregnancy.

The unadjusted herd weaning weights (Table 4) and measurement of vaginal length (Table 5) were taken in November each year.

Table 4. Effect of birth type and sex on average weaning weight (Kg). Standard deviation in brackets.

	Birth Type	Normal Heifer	Freemartin	Steer
2012	single	278.7 (43.8)		307.2 (45.6)
	twin	262.3 (24.9)	236.5 (51.2)	234.8 (23.3)
2013	Single	294.3 (31.1)		299.7 (37.1)
	Twin	230.7 (33.1)	248.0 (9.9)	254.3 (27.3)
2014	Single	277.2 (39.0)		298.4 (48.7)
	Twin	240.6 (40.9)	219.1 (32.5)	237.1 (31.4)

Table 5. Vaginal length (cms) measurements at weaning time. Standard deviations in brackets.

Year	Birth type	Vaginal length
2013*	Single	31.6 (3.3)
	Normal twin	27.6 (2.5)
	Freemartin	9.0 (1.2)
2014#	Single	31.9 (3.1)
	Normal twin	29.6 (2.4)
	Freemartin	10.5 (2.3)

\* one single born female with a length of 10 cms excluded, records show twins were conceived. # one mixed sex twin with a vaginal length of 30 cms excluded

## Discussion

The older literature suggests that the natural twinning rate in cattle is between 1 and 3%, with dairy cattle generally higher than beef cattle (British breeds). Parnell (pers comm.) has provided registration data for the Australian Angus Society showing a 1.9% twinning rate for the decade of the 1980's and 2.6% for the most recent decade. In Minnesota, the North American Holstein breed had a twinning rate of 4.2% (1.2% for nulliparous versus 5.8% for multiparous cows) and this was also increasing with time (3.4% in 1996 to 4.8% in 2004)<sup>2</sup>. Some North American Holstein data also shows that twin ovulations are higher in both older and high milk yielding cows<sup>3</sup>. The high milk production, parity 3 cows had a twin ovulation rate of 28% in that data set .

This local data clearly shows that the long term selection at USMARC has resulted in cattle with the ability to produce a lot of twins in our environment. We have recorded 38% twin conceptions and 23% twin calvings. Twin conceptions and twin calvings seemed to be lower in the heifers. The number of cows and heifers which failed to conceive and/or calve was disappointingly high. The herd itself is in a grading up process to twinning blood with many cows only having 50% twinner blood and we have been also increasing the poll gene. This also means that culling for normal fertility has not been as rigorous as would be expected in a normal herd. The age structure of the herd has not reached a steady state and in the cows reported on here are younger than most commercial herds.

Autumn calving in a winter rainfall area means that nutrition is often less than optimal through late summer, autumn and early winter, furthermore in the run of years involved here, 6 out of 9 have had significantly lower than normal rainfall including one quite severe drought year. Some of the zero conception and calving rates may be due to postpartum anoestrus or failure to reach puberty, although previous data with ET induced twins suggested that provided the twin rearing cows were at similar weights pre-mating, their pregnancy rates were similar to single rearing cows<sup>4</sup>. Since these zero conception rates do not contribute to the observations on relative twinning ability it is not unreasonable to suggest that the potential multiple calf conception rate could be as high as 48% and rate of multiple calves born 35%.

For cows recorded as conceiving with 1 calf, the foetal loss seems reasonable. For those recorded with 2 foetuses at the early pregnancy test, there is a serious loss of both foetuses in mid pregnancy and a further loss of 1 foetus at some stage during the pregnancy. Losses of this magnitude were unexpected, based on our experience with ET induced twinning<sup>5</sup> or from the USMARC herd data<sup>6</sup>. The USMARC data suggests that most cows from this bloodline have the capacity to gestate twin foetuses successfully to term, but this capacity is reduced in nulliparous heifers gestating 2 foetuses in one uterine horn or in all age groups gestating triplets. It is not clear if any aspects of management or nutrition are contributing to this loss in our herd. The high proportion of heifers is probably one significant factor. A possible avenue for some improvement might be to encourage a higher proportion of bilateral twin ovulations since the ET induced twins were bilateral and the USMARC data shows much better results from bilateral rather than unilateral ovulations. From a genetic point of view it is only now that the twin conception rate has risen that improvement in factors such as these can be addressed.

In this herd the weaning weight of a twin calf is about 80% of a single calf and this is consistent with the literature. In other words, a cow rearing twins produces 160% of the

weaning weight of a cow rearing a single. All the steer calves from this herd have been sold in the regional weaner sales each year. In the last couple of years they have consisted entirely of calves with twinner blood with about 1/3 twin born (in each year a few better twin born males have been retained as bulls). These steers have matched the other cattle entered in these sales for the range of weights, condition scores and prices.

Freemartins are often discussed in relation to twinning<sup>7</sup>. These are not a disadvantage in beef herds provided they are identified and put in the slaughter group. The vaginal length test can be simple confirmation of freemartinism. Using it in this herd, only one heifer born in a mixed sex group has so far been considered normal. A single born heifer and one set of female twins have been considered freemartins, both presumably had a male calf which died during pregnancy.

### **Conclusion**

It is clear that USMARC twinner cattle in a commercial herd can have a high twinning rate. In this herd they have recorded a 38% twin conception rate and a 22% twin calving rate with scope for further improvement as the age structure stabilises, the proportion of 100% twinner blood cows increases and management improves. However there are a number of problems still to be solved. From a veterinary point of view, ultrasound pregnancy diagnosis during early pregnancy can identify twin conceptions and provide the opportunity to allow much better management of twinning cows.

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