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Multiple pregnancy diagnosis of ewes using real time ultrasonic body scanner and video-fluoroscopy systems

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ABSTRACT

The pregnancy status of over 4700 ewes, divided into 21 flocks (137 to 688 ewes) and grazed on 14 properties in the Hawkes Bay, were diagnosed using either or both real time ultrasonic body scanner (ultrasonic) and video-fluoroscopy (X-ray) systems. The diagnosis was checked with the number of lambs born, dead or alive, to each ewe. For the ultrasonic system the percent of ewes whose lambing status was correctly predicted ranged from 96.1 to 100% for 19 flocks examined. In the case of the X-ray system the values for 13 flocks examined, except for one property, ranged from 94.3 to 99.6%. The operators must have a special aptitude in handling the instruments and interpreting an image on a screen if good results are to be obtained. The maximal throughputs for the ultrasonic and X-ray systems were 200 and 250 ewes per hour respectively.

The major differences between the two systems (ultrasonic v X-rays) were: i) The capital outlay for the ultrasonic system was about a twelfth of that of the mobile X-ray system. ii) A good backup-service is needed to maintain the X-ray equipment. iii) To sustain a throughput of over 200 ewes per hour, excluding the operator, 5 labour units were required for the sheep handling associated with the ultrasonic system compared to one for the X-ray system.

Keywords Sheep; pregnancy diagnosis; ultrasonic; video-fluoroscopy

INTRODUCTION

Pregnancy diagnosis is a technique that could improve flock management. Knowledge of the pregnancy status of the ewe allows for the early culling of non-pregnant animals and the separation of single and multiple bearing ewes so that preferential treatment can be given to the latter in terms of nutrition, shelter and shepherding. This can result in increased birth-weights, improved survival rates of twin lambs as well as higher milk production and better conditioned ewes (Blair, 1986).

This survey was designed to investigate the accuracy of ultrasonic (Memon and Ott, 1980;

Fowler and Wilkins, 1985; Fowler and Wilkins, 1984) and X-ray systems (Ardran and Brown, 1963; Beach, 1982) to determine the pregnancy status of ewes on farms in a commercial situation.

METHODS AND MATERIALS

Sheep

Mixed aged or cast-for-age ewes of the New Zealand Romney and Coopworth breeds were used. The animals were run as separate groups of 137 to 425 on 14 farms in Southern Hawkes Bay (Table 1) and were grazed on predominantly ryegrass/white clover type pasture. Polled Dorset

or Romney rams were used to mate the ewes.

Equipment

The ultrasonic system

The equipment used was a System XLP Model real time body scanner fitted with a 3.5 MHZ external probe (Dynamic Imaging, Scotland). Examinations were made on full-wool sheep by placing them on their rump so that the ultrasonic probe could be placed in the wool free groin area. The probe was then moved in an arc-like manner over the lower abdomen so that the entire uterus was scanned. To ensure good ultrasound transmission the probe was dipped in vegetable oil. The diagnosis was made by visual inspection of an image produced on the display screen of the ultrasonic unit.

X-ray system

The equipment used was the video fluoroscopy system developed by Beach (1982) but used in an approved continuous ('screening') mode. The entire system was built on to a truck together with a hydraulically operated conveyor system which transported the ewe from a loading race to a position for an X-ray examination. The diagnosis was made by visual inspection of an image on a screen.

The two operators using the ultrasonic and X-ray systems were very experienced and competent in handling their respective equipment.

Design of the Experiment

The ewes examined by ultrasound and by X-rays lambed in May - June or September.

(a) May - June Lambing Group: The sheep used for this survey consisted of 19 groups of ewes which were part of an out-of-season lambing programme in Hawkes Bay (Table 1). The ewes were treated with progesterone (CIDR) and pregnant mare serum (PMS) to stimulate them into oestrus for early mating from mid December 1985 to mid January 1986 so that lambing occurred from mid May to mid June 1986.

All ewes were individually identified with numbered ear tags. Between days 50 to 70 of gestation their pregnancy status was diagnosed and recorded using the ultrasonic system. The ewes were again examined between days 110 to 140 gestation using the X-ray system and their pregnancy status reassessed. The optimum gestational age for a diagnosis of pregnancy by the X-ray system is 95 to 120 days. However an unforeseen equipment maintenance delay postponed the examinations for 2 weeks. After X-ray the ewes were marked on the back with various colours and separated into 4 groups namely; non pregnant (0), single bearing (1), multiple bearing (2+), and a small group where there was a disagreement between the 2 systems as to the pregnancy status of the ewe.

As the criteria for assessing the accuracy of the pregnancy diagnosis by the two systems is entirely dependent on complete and accurate information concerning the number of lambs born dead or alive to each ewe, particular attention was given this aspect during the lambing. Just before lambing the ewes were sorted into groups according to their diagnosed pregnancy status and placed in different paddocks. During lambing they were observed daily and the number of lambs born to each ewe noted. As the ewes were individually ear-tagged and separated into probable lambing performance groups, this meant that any ewe which was incorrectly diagnosed could be easily recognised.

(b) September Lambing Group: For this part of the survey two groups of ewes were mated in early April 1986. One group of 425 ewes was examined using the X-ray system while another group of 416 ewes was examined using the ultrasonic system. The management of the ewes at lambing was as described for the May - June lambing group.

RESULTS

The data for each property namely (1) the number of ewes run with the ram, (2) the total number of lambs born (dead or alive), and (3) an assessment of the pregnancy status of the ewes by the ultrasonic and X-ray systems are presented in Table 1.

TABLE 1 Pregnancy status of individual ewes as diagnosed by the ultrasonic (U) and X-ray (X-R) systems and the number of lambs born to each ewe (L).

Property	Total ewes run with the ram	Total lambs born	Diagnostic method	Pregnancy status barren (0)	single (1)	multiple (2+)	% of ewes whose lambing status was correctly predicted
May - June lambing group							
A.M.			L	77	40	32	
Takapau	149	110	U	77	36	36	97.3
P.T.			L	94	58	47	
Porongahau	199	152	U	97	52	50	97.0
D.A.			L	178	118	66	
Porongahau	362	259	U	179	115	68	99.2
			X-R	163	128	71	95.8
A.L.			L	144	131	65	
Ashcott	340	269	U	142	129	69	98.8
			X-R	146	136	58	97.9
G.A.			L	77	53	34	
Omakere	164	127	U	78	53	33	99.0
			X-R	81	53	30	97.5
R.K.			L	116	47	34	
Otane	197	120	U	114	48	35	99.0
			X-R	115	53	29	96.5
D.Q.			L	192	148	77	
Otane	417	326	U	193	147	77	99.8
			X-R	197	139	81	97.8
T.T.			L	114	81	40	
Otane	235	167	U	114	83	38	99.1
			X-R	122	77	36	96.6
D.P.			L	133	150	63	
Argyle	346	276	U	133	153	60	99.1
			X-R	137	155	54	97.4
R.H.			L	97	69	86	
Takapau	252	247	U	96	69	87	99.6
			X-R	98	64	90	98.0
D.B.			L	70	86	40	
Maraekakaho	196	175	U	70	81	45	97.4
R.H.			L	110	80	60	
Takapau	250	207	U	110	79	61	99.6
			X-R	109	80	61	99.6
G.A.			L	88	33	52	
Omakere	173	143	U	87	32	54	98.8
			X-R	88	35	50	98.8
H.P.			L	142	27	24	
Elsthorpe	193	84	U	142	27	24	100.0
			X-R	147	33	13	94.3
R.G.			L	146	73	50	
Maraekakaho	269	179	U	148	67	54	97.8
R.H.			L	51	54	32	
Takapau	137	124	U	50	53	34	98.5
			X-R	50	50	37	96.3
D.A.			L	58	71	28	
Porangahau	157	133	U	58	67	32	97.5
D.Q.			L	96	79	32	
Otane	207	155	U	94	79	34	99.0
A.M.			L	55	82	46	
Argyl	183	179	U	55	82	46	100.0
			X-R	48	88	47	96.1
September lambing group							
D.Q.			L	9	272	144	
Otane	425	560	X-R	16	292	117	71.2
D.Q.			L	12	120	284	
Otane	416	688	U	11	135	270	96.4

The accuracy of a particular diagnostic system was determined by comparing the recorded number of foetuses carried by a particular ewe during the pregnancy examinations with the

number of lambs actually born to her. For example, a correct diagnosis was recorded only when a ewe predicted to be carrying a single foetus gave birth to a single lamb. If that ewe did not lamb or gave birth to several lambs then pregnancy diagnosis was recorded as incorrect.

For the early May - June lambing group of ewes, the mean number of non pregnant (0), single (1) and multiple bearing (2+) animals, expressed as a percent of the total were 46.1%, 33.4% and 20.5% respectively. The respective percentages in the 0, 1 and 2+ group for the smaller September lambing group of ewes were 2.5%, 46.6% and 50.9% respectively.

However when individual properties were considered, the accuracy of the ultrasonic system ranged from 96.4 to 100%. In the case of the X-ray system, the accuracy ranged from 95.8 to 98.8% except one farm where only 71.2% of the ewes were correctly diagnosed.

The throughput for the ultrasonic system ranged from 180 - 200 ewes/h while the range for the X-ray system was 200 - 250 ewes/h.

DISCUSSION

As the accuracy of the ultrasonic and X-ray systems is very much dependent on the experience and competence of the operators, the design of this study was unsuitable to compare accuracy of the two systems. However each system can be evaluated on its own merits in determining the pregnancy status of the ewe. As an evaluation of the two diagnostic systems depends on a complete and correct record of the number of lambs born to each ewe the practical problems of obtaining this data were carefully considered. The extent of the errors associated with identifying each lamb's dam such as desertion of lambs, lambs being stolen by other ewes and the failure of the ewe to keep her litter together have been investigated (Alexander *et al.*, 1983). To improve the accuracy of the data collected the ear tagged ewes were divided into various groups according to their predicted pregnancy status just prior to lambing and placed in different paddocks. The lambing ewes were inspected once or twice each day.

When all flocks and pregnancy statuses are

considered the overall correct diagnoses expressed as a percent of the total ewes diagnosed were 99.6% and 97.3% for the ultrasonic and X-ray techniques respectively. This level of accuracy is acceptable and would provide adequate information on the pregnant status of ewe for flock management decisions.

The operator must possess a special aptitude in handling the instrumentation and interpreting the image if good results are to be obtained. Further, as the operator must concentrate on a screen and make a quick diagnosis of the pregnancy status of the ewe, a number of short rest periods should be taken to prevent a loss of concentration otherwise a number of ewes will be incorrectly diagnosed. In the case of the ultrasonic system there is a tendency for trained operators to fail to see the foetuses that are there, while learners tend to see foetuses that are not really there. This malady is termed 'imaginitis' by ultrasonographers. It arises through the incorrect orientation of the ultrasound transducer which causes the untrained operator to image a single foetus from several different angles and thus incorrectly conclude that two foetuses are present. The slightly poorer performance by the X-ray technique may possibly be explained by the unfortunate 14-day delay in carrying out the examination of the ewes. The optimum time for X-ray examination is 95 to 120 days, not 110 to 140 days of gestation. As the uterine volume increases it becomes more X-ray absorptive while the larger foetus(es) exceeds the diagnostic field of view. In most cases (6 out of 7) the multiple pregnancies (2+) where the diagnostic accuracy of the X-ray system was less than 90%, the number of ewes carrying multiple foetuses was under-estimated while the number of ewes carrying a single foetus or which were non pregnant was over-estimated. A possible explanation is that at the time of making the diagnosis of the pregnant ewe, one foetus may have 'masked' the others.

The two systems were different in terms of capital investment and labour input. The capital outlay (\$15,000) for the ultrasonic system was about 8% of that for the X-ray system, but the labour input for the ultrasonic system was very high. To maintain a high maximal throughput of 200 - 250 ewes/h, four to five persons were

required to catch and present the animals for examination by the ultrasonic system. The efficiency of the ultrasonic system in terms of labour could be improved if a suitable sheep handling facility was designed for it. In contrast the capital investment for the X-ray system is high and general backup services are required to maintain it. Further the life of the expensive X-ray image tube is probably less than 10 years. However, one person plus the operator can maintain a high throughput using the X-ray system.

Another important difference between the two systems is the timing of the pregnancy diagnosis. For the ultrasonic system a suitable time is 45 to 100 days of gestation to determine litter size and from 45 days to term for pregnancy diagnosis (Fowler and Wilkins, 1984). At 60 days gestation a singleton conceptus can weigh 1420 g with the foetus and placental fluids weighing 86 and 382 g respectively, while at 100 days the conceptus increases to 2850 g and the foetus and placental fluids weigh 1040 and 705 g respectively (Grace *et al.*, 1986). As the placental fluids become proportionally less, there is an associated loss of the image of the foetus. At 50 to 70 days of gestation the foetal skeleton is not well developed and calcified (Grace *et al.*, 1986) and therefore it is not until about 100 days of gestation when the calcification is 75 to 80% completed that X-rays can be used to detect the presence of the foetus(es) with a high degree of accuracy.

A pregnancy diagnostic programme could be expected to cover 8 to 10 weeks per year examining some 40 000 to 60 000 ewes per system if extended lambing programmes become more widespread. The two systems could complement each other in that the ultrasonic system is more suitable for pregnancy diagnosis and determining

litter size in the early part, while the X-ray system is more suited for the later part of gestation.

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