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REPRODUCTIVE PERFORMANCE OF MERINO EWES DOSED WITH SELENIUM PRIOR TO MATING

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SUMMARY

Dosing Merino ewes with 5 mg selenium approximately 17 days before mating significantly reduced the proportion of barren ewes by 12% in three out of four trials. The reduction in barrenness associated with pre-mating selenium administration was greater for ewes grazing ryegrass/clover pastures (15.0%) than for ewes grazing lucerne pasture (8.9%). The application of selenium to the pasture via superphosphate prior to mating significantly reduced the proportion of barren ewes by 8% relative to control ewes, but was not as effective as oral dosing (14.3%) under the experimental conditions imposed.

Dosing ewes with 5 mg selenium prior to lambing in addition to mating, significantly reduced lamb mortality from birth to weaning. Little additional response was obtained by dosing lambs with selenium at tailing, although in the absence of selenium at lambing, substantial reductions in lamb mortality and improvements in weaning weights were made.

INTRODUCTION

The South Island high country covers an area of over 3 million ha and includes in excess of 1.7 million sheep of which approximately half are Merinos. Recent survey results (Hughes, 1973) indicated that lambing percentages of Merino flocks were little better than 80%. The extent to which selenium deficiency is responsible for the poor reproductive performance in Merino flocks has not been fully ascertained. Hartley and Grant (1961) showed that dosing ewes with selenium one month prior to mating and repeated monthly up to lambing dramatically reduced the incidence of barrenness in Romney ewes. Later, Hartley (1963) reported that the effect of pre-mating selenium administration was to reduce the embryonic mortality between three and four weeks post conception.

The objectives of this experiment were to examine the reproductive performance of Merino ewes dosed with selenium prior to mating and to determine whether this response was consistent with differing seasons, pasture types and method of selenium administration.

EXPERIMENTAL

A series of 5 trials was conducted between 1967 and 1973 at the Tara Hills High Country Research Station and Ohau Downs Station in the Omarama district of North Otago.

Trial 1 (1967): This trial was exploratory in nature and designed to isolate the causes of poor reproductive performance in Merino ewes. One hundred-and-twenty-five Merino 2-tooth and 8-tooth ewes were joined with 4 Merino rams for a 7-week mating period commencing May 10. Ewes were grazed at 13/ha on lucerne pastures during mating and subsequently lambed on ryegrass/clover pastures where observations were recorded on reproductive performance.

Trial 2 (1968): Five-hundred Merino 2-tooth ewes were allocated to a pre-mating selenium dosing treatment and a control treatment. Treated ewes were dosed with 5 mg selenium 17 days prior to mating and both groups subsequently transferred to either lucerne or ryegrass/clover pastures. Two rams per 100 ewes were added on May 10, for a 6-week mating period. All ewes were lambed on ryegrass/clover pastures where observations on reproductive performance were recorded. At tailing (November 25, 1968) half of all lambs were dosed with 2 mg selenium.

Trial 3 (1968): This trial was conducted on Ohau Downs, a typical extensive sheep run in the Omarama district. Three-hundred-and-thirty mixed-aged Merino ewes were randomly allocated to a pre-mating selenium and control treatment. Treated ewes were dosed with 5 mg selenium 17 days prior to joining with rams and both groups subsequently mated together at the rate of 2 rams per 100 ewes on unimproved tussock blocks at a stocking rate of 1 ha/ewe. Details of barren ewes, wet/dry ewes and lambs tailed were recorded on December 2, 1968.

Trial 4 (1969): Four-hundred Merino 2-tooth ewes were randomly allocated to the following three treatments at mating: single oral dose of 5 mg selenium 27 days prior to mating, pasture selenium administration via the fertilizer and a control treatment. A 24 ha irrigated ryegrass/clover mating block was subdivided into three replicated areas and allocated to the above treatments. All areas were topdressed with 125 kg of superphosphate/ha 21 days prior to mating, the selenium-fertilizer replicates containing 68 g sodium selenate (31 g Se)/ha in addition to the fertilizer. Grazing commenced 16 days prior to mating and rams added at the rate of 1 to 60 ewes on May 14. Ewes subsequently lambed on ryegrass/clover pastures where observations on lambing performance were recorded.

Trial 5 (1973): Three-hundred-and-sixty Merino 4-tooth ewes were randomly allocated to a pre-mating selenium treatment, a pre-mating and pre-lambing selenium treatment and a control treatment. Both pre-mating selenium groups were dosed with 5 mg selenium 21 days prior to mating. Rams were added at the rate of 1 to 60 ewes on May 8 and all treatments grazed together on a 164 ha improved tussock hill block at a stocking rate of 2.2 ewes/ha. Following wintering on hill blocks the pre-lambing selenium treatment ewes were dosed with 5 mg selenium 2 weeks before lambing. Ewes lambed on either lucerne or ryegrass/clover pastures at approximately 20 ewes/ha. At tailing (November 6, 1973) half of the lambs from each treatment were dosed with 2 mg selenium.

RESULTS AND DISCUSSION

LAMBING PERFORMANCE OF MERINO 2-TOOTH AND 8-TOOTH EWES

Trial 1 (1967): A comparison of the reproductive performance of 2-tooth and 8-tooth Merino ewes is presented in Table 1. It is apparent that the low percentage of lambs weaned from 2-tooth ewes can be directly attributed to the low level of twinning and the high proportion of barren ewes. Two-tooth lamb mortality was relatively low which is inconsistent with the concept that the 2-tooth Merino ewe is of poor maternal ability.

Although 2-tooth barrenness was high, liveweights were approximately 45 kg at mating, which can be regarded as well.

TABLE 1: REPRODUCTIVE PERFORMANCE OF MERINO 2-TOOTH AND 8-TOOTH EWES¹ (1967)

	2-tooth %	8-tooth %	Difference %
Barren ewes	28.8	15.2	— 13.6**
Twin-bearing ewes	6.4	30.4	24.0**
Lambs born	77.6	116.0	38.4**
Lambs stillborn ²	5.1	2.7	— 2.4NS
Lamb mortality ³	4.3	9.2	4.9NS
Lambs weaned	70.4	102.4	32.0**
Age at weaning (days)	101	106	5 **

¹ Data expressed as a percentage of ewes joined with the ram.

² Percentage of lambs born.

³ Percentage of lambs born alive.

TABLE 2: COMBINED EFFECTS OF DOSING WITH SELENIUM PRIOR TO MATING AND PASTURE TYPE AT MATING ON THE REPRODUCTIVE PERFORMANCE OF MERINO EWES¹ (1968)

	<i>No Selenium/ Lucerne %</i>	<i>Selenium/ Lucerne %</i>	<i>Difference %</i>	<i>No Selenium/ Ryegrass %</i>	<i>Selenium/ Ryegrass %</i>	<i>Difference %</i>
Barren ewes	14.7	5.8	— 8.9*	20.0	5.0	— 15.0**
Twin-bearing ewes	4.0	4.1	0.1NS	0.9	4.2	3.3NS
Lambs born	90.2	98.3	8.1*	80.9	99.1	18.2**
Lambs stillborn ²	2.7	3.4	0.7NS	1.1	0.8	— 0.3NS
Lamb mortality ³	9.3	6.1	— 3.2NS	5.4	9.4	4.0NS
Lambs weaned	79.5	89.2	9.7NS	75.6	89.1	13.5*

¹ Data expressed as a percentage of ewes joined with the ram.

² Percentage of lambs born.

³ Percentage of lambs born alive.

TABLE 3: EFFECTS OF DOSING WITH SELENIUM PRIOR TO MATING AND PASTURE TYPE AT MATING ON THE REPRODUCTIVE PERFORMANCE OF MERINO EWES¹ (1968)

	<i>Control %</i>	<i>Selenium %</i>	<i>Difference %</i>	<i>Ryegrass %</i>	<i>Lucerne %</i>	<i>Difference %</i>
Barren ewes	17.3	5.4	— 11.9**	12.4	10.3	— 2.1NS
Twin-bearing ewes	2.5	4.2	1.7NS	2.5	4.1	1.6NS
Lambs born	85.6	98.7	13.1**	90.2	94.2	4.0NS
Lambs stillborn ²	1.9	2.1	0.2NS	0.9	3.1	2.2NS
Lamb mortality ³	7.5	7.8	0.3NS	7.6	7.7	0.1NS
Lambs weaned	77.6	89.1	11.5**	82.5	84.3	1.8NS

¹ Data expressed as a percentage of ewes joined with the ram.

² Percentage of lambs born.

³ Percentage of lambs born alive.

grown compared with the 35 kg average reported in high country 2-tooth flocks (Coop and Clark, 1966). Recent work by Allison (1973) has shown that barrenness in 2-tooth ewes can be markedly reduced by increasing the proportion of rams joined with the ewes at mating, which could explain the large difference in barrenness between the age groups in the present study, since rams were joined with both groups at the rate of 1 to 64 ewes. However the extent to which selenium deficiency during mating was responsible for impaired reproductive performance in the above study is not known, although the trial isolated fertility problems that were more closely examined in subsequent trials.

EFFECT OF PRE-MATING SELENIUM ADMINISTRATION ON EWE FERTILITY

Trial 2 (1968): The effect of dosing 42 kg 2-tooth Merino ewes with 5 mg selenium 17 days prior to mating is shown in Table 2. Selenium administration significantly ($P < 0.01$) reduced the proportion of barren ewes relative to control animals resulting in a substantial increase in the proportion of lambs born, especially on ryegrass/clover pastures. The reduction in barrenness associated with selenium dosing was consistent for all liveweights and was not accompanied by a proportionate increase in liveweight during the mating period (1.4 vs 1.7 kg for control and selenium, respectively). Although the proportion of multiple births and lamb mortality from birth to weaning was little affected by selenium at mating, the percentage of lambs weaned was increased by 11.5% (Table 3). While the responses to selenium are less than those reported by Hartley (1963) they nevertheless represent substantial increases in lamb production.

The mean date of lambing (October 21, 1968) together with lamb liveweights at birth or weaning were little affected ($P > 0.05$) by pre-mating selenium administration. Dosing

TABLE 4: EFFECT OF DOSING MERINO EWES PRIOR TO MATING ON REPRODUCTIVE PERFORMANCE¹ (OHAU DOWNS, 1968)

	Control %	Selenium %	Difference %
Barren ewes	35.2	23.7	— 11.5*
Wet/dry ewes	1.9	5.2	3.3NS
Lambs tailed	64.0	73.0	9.0**

¹ Data expressed as a percentage of ewes joined with the ram.

TABLE 5: COMPARISON OF PRE-MATING SELENIUM ADMINISTRATION METHODS ON THE REPRODUCTIVE PERFORMANCE OF 2-TOOTH MERINO EWES¹ (1969)

	<i>Control</i> %	<i>Oral Dosing</i> %	<i>Fertilizer-Selenium</i> %
Barren ewes	20.1 a	5.8 b	12.1 b
Twin-bearing ewes	3.9 a	2.5 a	5.6 a
Lambs born	83.7 a	96.7 b	93.5 b
Stillborn lambs ²	0.9 a	0 a	2.6 a
Lamb mortality ³	2.8 ab	7.7 a	2.6 b
Lambs weaned	80.6 a	89.2 b	88.7 b

¹ Data expressed as a percentage of ewes joined with the ram.

² Percentage of lambs born.

³ Percentage of lambs born alive.

ab: Differing letters among rows denote significant differences among treatment means ($P < 0.05$).

TABLE 6: PASTURE AND BLOOD SELENIUM LEVELS (TARA HILLS, 1969)

<i>Days after Topdressing</i>	<i>Pasture ppm</i>			<i>Blood ppm</i>		
	<i>Pre-mating</i> — 5	<i>Mating</i> 57	<i>Lambing</i> 156	<i>Pre-mating</i> — 6	<i>Mating</i> 48	<i>Lambing</i> 156
Control	0.012	0.042	0.011	0.023	0.032	0.026
Oral — Se	0.014	0.045	0.019	0.017	0.058	0.034
Fertilizer — Se	0.008	3.350	0.140	0.017	0.307	0.221

lambs with 2 mg selenium at tailing failed to increase weaning weights or reduce lamb mortality and was independent of the ewe's selenium status at mating.

The reproductive performance of ewes grazing lucerne or ryegrass/clover pastures at mating was similar and differences in the proportion of barren ewes and twin-bearing ewes failed to reach significance. Coop and Clark (1960) have shown reductions of up to 10% in twinning rate and increases of up to 1 to 2% in barrenness in ewes mated on lucerne pastures. The discrepancy between their data and the present results may be explained by the fact that lucerne-grazed ewes gained 3.1 kg more liveweight during the 6-weeks mating period than ryegrass-grazed ewes. However, regression of twinning rate on liveweight gain during mating showed an increase in twinning of 4.8% for every 10 kg liveweight gain which can be compared with the value of 13% reported by Coop (1962) for Corriedale ewes. Correcting the twinning rate of the lucerne group on the basis of Coop's estimate reduced the proportion of lambs born by only 4% which was insufficient to create differences between the two pasture types.

Trial 3 (1968): Results of the Ohau Downs investigations are presented in Table 4. Pre-mating selenium administration substantially decreased the proportion of dry ewes and increased the tailing percentage by 9%. Lamb mortality as measured by the proportion of wet/dry ewes was not significantly reduced by the pre-mating selenium treatment. The reduction in barrenness associated with the selenium treatment was independent of the liveweight at mating and of the age of the ewe, although results were variable.

METHODS OF SELENIUM ADMINISTRATION

Trial 4 (1969): A comparison of different methods of selenium administration to 2-tooth Merino ewes prior to mating is presented in Table 5. The proportion of barren ewes in the control group was reduced from 20.1% to 5.8% with a single oral dose of 5 mg selenium 21 days prior to joining with the rams, although twinning rates and lamb mortality were unaffected. Higher lamb mortality in the oral selenium group, while not significant, was responsible for the reduced advantage in weaning percentage.

While the reduction in barrenness associated with ewes grazing selenium-topdressed pastures during mating was not of the same magnitude as oral dosing, it was nevertheless substantial and significant. As with oral dosing, the proportion of lambs born was considerably improved, resulting in an 8.1%

increase in the weaning percentage. With the exception of barren ewes there were few differences between oral dosing and selenium/fertilizer treatments.

The application of selenium in the form of Na_2SeO_3 to the pasture via fertilizer is a convenient method of administration to grazing animals and has been shown to be effective in raising pasture selenium levels (Van der Elst and Watkinson, 1972). The reason for the lowered performance of the selenium/fertilizer treatment relative to the oral dosing treatment in reducing the proportion of barren ewes is not clear. Possible time lag factors may be involved since the ewes commenced grazing selenium-topdressed pastures only 16 days before mating, which may have been insufficient time for assimilation of adequate amounts of selenium into the blood and tissue system. However, Davies and Watkinson (1966) have shown that considerable foliage contamination occurs, resulting in substantial consumption of selenium in the first 30 days following selenium application. This would appear consistent with the present results (Table 6) which show large increases in pasture selenium levels following an application of 35 g Se/ha. Toxicity factors as reported by Grant (1965) could also be involved. Levels increased up to 3.35 ppm 57 days after topdressing but declined to 0.14 ppm 156 days after application. Oral dosing with selenium has increased the blood selenium levels above the control animals which suggests that blood selenium levels of 0.032 ppm and corresponding herbage levels of 0.012 to 0.042 ppm are insufficient to avoid infertility problems.

TABLE 7: EFFECT OF PRE-MATING AND PRE-LAMBING SELENIUM ADMINISTRATION ON LAMBING PERFORMANCE OF MERINO EWES¹ (1973)

	Control %	Selenium (mating) %	Selenium (mating and lambing) %
Barren ewes	5.3 a	6.0 a	7.6 a
Twin-bearing ewes	0.8 a	3.4 a	2.5 a
Lambs born	95.7 a	97.4 a	94.9 a
Lambs stillborn ²	1.8 a	2.6 a	3.6 a
Lamb mortality ³	15.4 a	19.8 a	0.9 b
Lambs weaned	79.5 a	76.1 a	90.7 b

¹ Data expressed as a percentage of ewes joined with the ram.

² Percentage of lambs born.

³ Percentage of lambs born alive.

ab: Differing letters among rows denote significant differences among treatment means ($P < 0.05$).

TABLE 8: EFFECT OF SELENIUM ADMINISTRATION TO EWES AND LAMBS ON LAMB MORTALITY FROM BIRTH TO WEANING (1973)

<i>Ewe Treatment</i>	<i>Control</i>		<i>Selenium (mating)</i>		<i>Selenium (mating and lambing)</i>	
	<i>Se %</i>	<i>Nil %</i>	<i>Se %</i>	<i>Nil %</i>	<i>Se %</i>	<i>Nil %</i>
<i>Lamb Treatment</i> ¹						
Lamb deaths — birth to tailing ²	—	7.0 ab	—	17.1 a	—	1.8 b
Lamb deaths — tailing to weaning ³	0	24.5**	2.1	20.7**	0	0NS
Lamb deaths — birth to weaning ²	0	29.8**	2.1	34.4**	0	1.8NS

¹ Lambs dosed with 2 mg selenium at tailing (Nov. 6, 1973).

² Percentage of lambs born alive.

³ Percentage of lambs alive at tailing.

ab: Differing letters among rows denote significant differences among treatment means ($P < 0.05$).

SELENIUM AT MATING AND LAMBING

Trial 5 (1973): A comparison of the reproductive performance of Merino 4-tooth ewes dosed with 5 mg selenium 20 days prior to joining with rams and undosed ewes is presented in Table 7. The proportion of barren ewes, twin-bearing ewes and lambs born was not affected by pre-mating selenium administration. Although the pasture selenium levels were relatively high (0.035 to 0.039 ppm) during mating, they were comparable with levels observed in 1969 in which a selenium-responsive, ewe-barrenness problem was encountered. However, it is possible that the herbage selenium levels may differ from that selected by the ewe, an effect magnified by the diverse plant species available. Although ewe liveweight at mating (37 kg) was lighter than in the 1969 trial (46 kg), gains during the mating period (2 kg) were comparable. As with previous trials the response to selenium was not affected by the liveweight at mating. The variability in selenium response between the two seasons highlights the problems of using pasture selenium levels as an indicator of the magnitude of the selenium-responsive barren-ewe problem, especially under the diverse vegetative and management conditions experienced in high country areas.

Table 8 shows the effect of dosing ewes prior to lambing on lamb mortality together with the influence of a single dose of selenium to lambs at tailing. Dosing ewes at lambing markedly reduced lamb mortality from birth to weaning. The reduction in lamb mortality associated with dosing lambs at tailing was confined to lambs from ewes not previously dosed at lambing. Although dosing ewes at lambing significantly increased lamb weaning weights (Table 9), dosing lambs from treated ewes failed to elicit further responses and is consistent with the findings of Hartley (1961). Dosing lambs from

TABLE 9: EFFECT OF SELENIUM ADMINISTRATION TO EWES AND LAMBS ON LAMB WEANING WEIGHTS (1973)

<i>Ewe Treatment</i>	<i>Lamb Treatment</i> ¹		
	<i>Control</i> <i>kg</i>	<i>Selenium</i> <i>kg</i>	<i>Difference</i> <i>kg</i>
Control	19.0 a	21.2 a	2.2*
Selenium (mating)	18.9 a	21.5 a	2.4*
Selenium (mating and lambing)	20.9 b	21.4 a	0.5NS

¹ Lambs dosed with 2 mg selenium at tailing (Nov. 6, 1973).

ab: Differing letters among columns indicate significant differences among means ($P < 0.05$).

untreated ewes increased weaning weights to levels comparable with lambs from treated ewes. Greatest responses to selenium at tailing were obtained with lambs grazing lucerne pastures as compared with ryegrass/clover pastures, which to some extent is explained by the lower pasture selenium levels in the lucerne group (0.040 ppm vs 0.026 ppm for ryegrass and lucerne, respectively).

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