Time of Mating as a Factor influencing Prolificacy in Cross-Bred Ewes, and its Effect upon Lamb and Wool Production in the Fat Lamb Flock.

W. G. ALLDEN*

SUMMARY

THIS paper compares the productivity of three flocks of cross-bred ewes mated to fat lamb sires at three different periods of the breeding season, and shows that delaying mating until the third month of the breeding season has increased the lamb drop by nearly 50 per cent. The average per cent. lamb drop for each group over 4 matings was 113, 136 and 165 per cent. for the early, mid-season and late-mated groups respectively. Later mating has produced fewer dry ewes and heavier birth weights in lambs. All these differences are significant statistically.

Differences in prolificacy were not related to the nutritional status of ewes at mating, but possibly to the effect of changing physical factors of the environment upon the ewe.

In this investigation under a specific environment meat production per acre has been highest in the late-mated group, with the mid-season mating holding an intermediate position, and wool production has not been affected by high lamb output.

Lamb mortality, growth and slaughter data are given and flocks are compared.

The importance of time mating as an agency which can influence prolificacy in sheep and can increase output in the fat lamb flock is discussed.

INTRODUCTION

The influence of time of mating upon ewe productivity has yet to be studied in adequate detail. In Europe, Johansson and Hansson (1943) studied the seasonal distribution of births and the seasonal variation in prolificacy (number of lambs per birth) for the Swedish strains of Shropshire and Cheviots, and produced clear evidence that the average number of births per ewe rises until the middle of the mating season and then declines. Hammond (1944) working with a small flock of ewes found the number of lambs per fertile service rose to a peak in November (autumn) and then declined steadily. Roberts (1921) also found the highest frequency of multiple births in the second to fourth month of the lambing season, but other authors (Heape, 1899; Marshall, 1908; Marshall and Potts, 1921; Nichols, 1924; and Biegert, 1938) generally concluded that more multiple births occurred early in the season.

In Australia, Watson (1951) has demonstrated a seasonal variation in ovulation rate in Merinos under two different environments. At both centres the incidence of twin births from matings during the autumn months was high. The author ascribed the high incidence of twin ovulations at Tooradin, Victoria, to nutritional effects following the autumn break of the season, but suggested that other changing physical factors of the environment were also responsible for the raising of the reproductive activity.

Miller and McHugh (1955) report briefly on a time of mating trail at Rutherglen, and without quoting figures observe that the question of lambing percentages still needs further clarification.

In 195 1 a field study was initiated at the Kybybolite Research Centre in the South East of South Australia to assess the effect of time of mating upon prolificacy in the ewe, and upon fat lamb production in a specific environment.

A high proportion of Australia's fat lamb output is produced in the Mediterranean type environment of the closer settled areas of South Eastern Australia, and the length of season suitable for fat lamb raising in these areas is limited. The customary mating time in these districts is from December to mid-January.

In designing the trial it was reasoned that if time of mating could be shown to affect prolificacy there still remained the need to fit the information

*Research Centre, Kybybolite, Department of Agriculture, South Australia.

to suit the environment. Accordingly much of this study is devoted to assessing the suitability of the different times of mating for fat lamb production as a whole in the meadow podsolic — annual pasture environment of the Lower South East of South Australia.

The "farm" design was selected as being most suitable for this study, giving a good index of the influence of treatment and environmental effects under normal fat lamb production conditions.

Mating dates, stocking rates and breed of ewes and sire were selected arbitrarily, and the aim has 'been to produce high-quality, lightweight lamb suitable for export to the United Kingdom.

MATERIAL AND METHODS

(i) Location: The study was carried out at Kybyolite in the lower south east of South Australia. The environment is Mediterranean in nature, typified by periods of winter rainfall and summer drought. The average rainfall is 21.89 inches, effective for 8.1 months during the period April to November.

(ii) Constitution of flocks and mating procedure: Three hundred well-grown first-cross Border Leicester x Merino ewe weaners were allocated at random to three groups of 100 sheep each. The dams of these ewes were large-framed, strong-woolled South Australian Merinos.

Each group was allocated a "farm" of four paddocks for its permanent use, and the stocking rate was set at 2.9 breeding ewes per acre.

Each group of ewes was joined to the rams during a different period of the breeding season. Mating periods ran consecutively and the mating of the three flocks covered an interval of 18 weeks, from December 15th to April 17th, as shown in Table 1.

TABLE 1

	"Teaser" rams		Entire rams		Lambing	
Flock	In	Out	In	Out	From	To
Early mated	Dec. 1	Dec. 15	Dec. 15	Jan. 25	May 13	June 23
Mid-season mated	Jan. 12	Jan. 25	Jan. 24	Mar. 7	June 23	Aug. 3
Late mated	Feb. 22	Mar. 7	Mar. 7	Apr. 17	Aug. 3	Sept. 13

(iii) Procedure — Lamb birth, growth and slaughter data: Lambs were weighed, tagged, and identified with their dams within 16 hours of birth. Further weighings were made when the mean age of the flock was 84 days, and at slaughter. Lambs were slaughtered at a weight suitable for the lightweight export lamb trade, and carcasses were identified over the hooks at slaughter and graded.

Lamb mortalities were assessed following a post-mortem examination.

RESULTS

(i) Lambing percentages: The highly significant differences between the three groups in respect of lambing percentages are illustrated in Figure 1. The late-mated group were favoured over the mid-season mated group, which in turn was significantly better than the early-mated group.

(ii) The lambing pattern: In general, the early-mated group has been slow to commence lambing and the period over which lambs were dropped has been prolonged. The pattern of lambing in the mid-season and late-mated groups has been more concentrated as shown in Figure 2. The percentage of fertile ewes which lambed within the first seventeen days of the lambing period in each of the four years under review is shown in Table 3.

TABLE 2

LAMBING DATA, 1952-1955

	1952			1953			1954			1955		
	Period of mating											
	Early season Falling	Mid-season Falling	Late season Rising	Early season Rising	Mid-season Static	Late season Falling	Early season Rising	Mid-season Rising	Late season Falling	Early season Falling	Mid-season Falling	Late season Rising
Body weight status at mating—												
Dry ewes* (%)	14	7	2	10	9	1	6	9	1	7	3	0
Lambs born to ewes mated* (%)	91	112	160	106	129	158	128	151	159	126	152	181
Lambs marked to ewes mated* (%)	87	102	145	99	119	145	122	141	146	119	143	157
Lambs born to ewes which lambed† (%)	107	120	163	118	142	160	136	166	162	135	156	182

†The late-mated flock had significantly fewer dry ewes than the other two flocks.

*Differences between flocks in lambing data are significant ($P < 0.001$) and there is agreement between years.

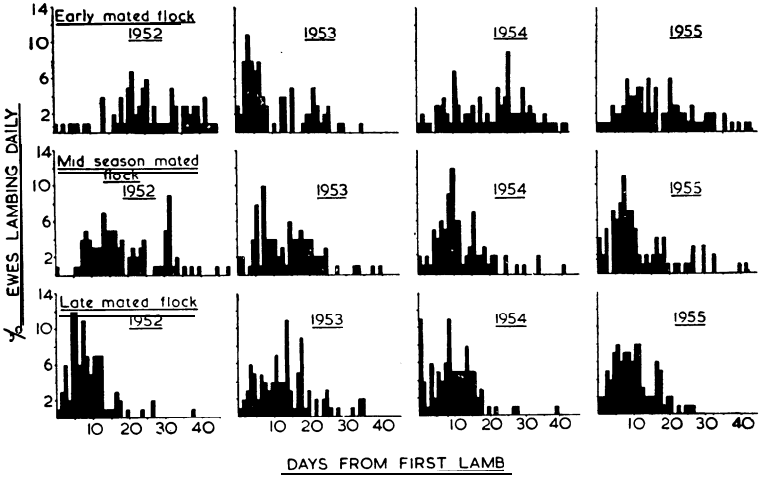

FIGURE 1: The consistent and marked differences in lambing percentages between the three flocks.

Details of lamb production and the bodyweight status of the ewes at mating, together with the percentage of dry ewes each year are given in Table 2. There have been significantly fewer dry ewes in the late-mated group, and this factor, coupled with higher number of multiple births, has led to the greatest output of lambs.

TABLE 3

Group	% fertile ewes lambing within first 17 days of lambing period (%)			
	1952	1953	1954	1955
Early-mated	16	75	39	52
Mid-season mated	64	66	74	75
Late-mated	92	72	92	91

(iii) Comparison of Birth Weights: Differences in birth weight have been observed between similar classes in different groups within the same year, and heavier birth weights were associated with the later matings. In 1953 and 1955 the late-mated group produced lambs in all classes which are significantly heavier than lambs from the early-mated group. In no instance were birth weights in the early-mated group significantly greater than corresponding weights in the other two groups. These differences are illustrated in Figure 3. In general, the later matings have produced lambs of heavier birth weights, and this has been more pronounced in cold, wet winters (1953, 1955) than in a mild winter (1954). Birth weights have varied from year to year, probably due to seasonal effects and to the age of ewe.

(iv) Lamb mortalities: Lamb losses, which have been principally due to mis-mothering or udder abnormality, have been much greater among twin lambs than among single lambs. Of the 126 lambs which died from birth to marking, 105 (83 per cent.) have been twins. Losses totalled 8.0, 8.5 and 10.4 per cent. for the early, mid-season and late-mated flocks respectively over the 4 year period; details are shown in Table 4. In all, 611 lambs were from single births, and 1,031 were from multiple births, so that the losses in each class from birth to marking totalled 3.5 and 10.2 per cent. respectively.

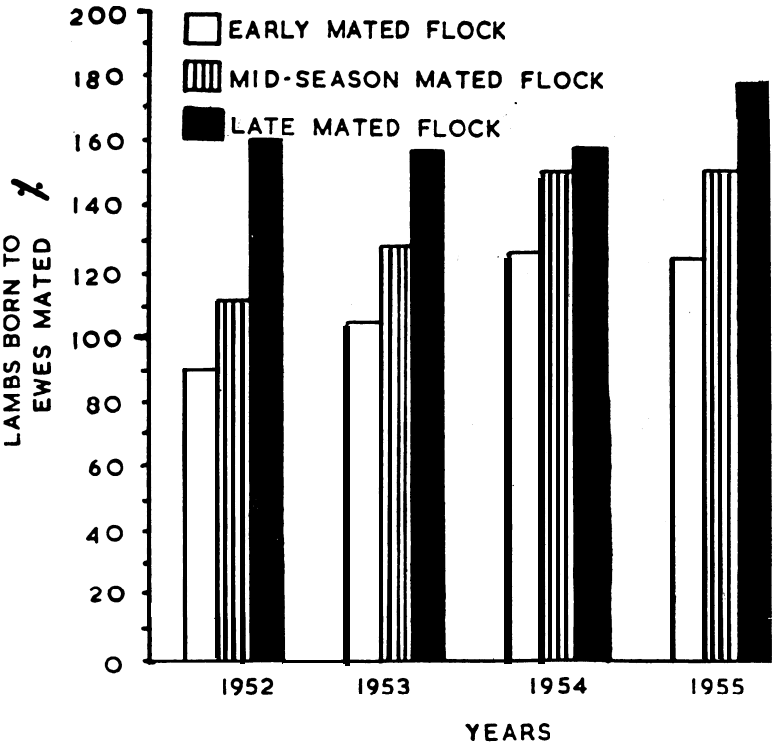

FIGURE 2: The lambing pattern of each flock over the four-year period.

TABLE 4

LAMB MORTALITIES — 1952-1955

Suspected cause of death	Lamb mortalities 0-3 days				Lamb mortalities 3 days — market			
	Early	Mid	Late	Total	Early	Mid	Late	Total
Ewe with abnormal udder appearance or function	5	9	10	24	4	2	5	11
Injured	—	1	—	1	—	—	—	—
Infection	—	—	—	—	6	5	2	13
Killed by predators	1	1	1	3	1	—	1	2
Mis-mothered	4	14	11	29	5	4	7	16
Adverse weather	—	—	13	13	—	—	1	1
Abnormality	4	5	3	12	1	—	1	2
Stillborn	2	4	7	13	—	—	—	—
Marking	—	—	—	—	1	—	2	3
Other	1	—	2	3	4	1	3	8
Abnormal presentation	1	—	1	2	—	—	—	—
Total	18	34	48	100	22	12	22	56

(v) Rate of growth of lambs: Growth rates have been calculated over the periods from birth to 84 days (mean age of flock), and from birth to slaughter, and are illustrated in Figure 3. Lambs from the late-mated flock grew significantly faster than the early-drop lambs in years 1952, 1953 and 1955, but in the abnormally mild season of 1954 the early-drop lambs grew more rapidly over the period birth to slaughter. The mid-season mated flock lambs made gains comparable to the late-mated group, and they were able to sustain these growth rates over a longer period, thus producing heavier lambs for market.

At the stocking rates prevailing in this experiment the data show that the early-mated flock was at a disadvantage due to a shortage of feed during the autumn and winter months of a normal or adverse season, and this period of nutritional stress was reflected in the lower growth rates of the lambs. Lambs from the late-mated group have grown most rapidly, but the length of this period of fast growth has been restricted by the advance of spring and the maturity of pasture herbage. Lambs from the mid-season mated flock gained well on good feed and were able to exploit the longer growing season to better advantage. This time of lambing would appear to be most favourable for lamb production under the conditions prevailing here.

(vi) Marketing of lambs — Weight. and Grade: Lambs have been marketed and slaughtered to meet the requirements of the export market, the aim being to produce lamb of the highest quality in the medium to lightweight range.

Lambs from the early mid-season mated flocks have usually been marketed within an average weight range of 34 to 36 lb., but in no year have lambs from the late-mated group exceeded a mean carcass weight of 32 lb. In Table 5 the weights and grades of lambs from the different flocks have been compared.

TABLE 5

COMPARISON OF THE CARCASS WEIGHT AND GRADE OF LAMBS FROM THE DIFFERENT FLOCKS

	Group	Year			
		1952	1953	1954	1955
CARCASS WEIGHT (lb.)	Early-mated	34.41	31.73	35.46	35.64
	Mid-season mated	34.56	31.99	33.53	34.61
	Late-mated	31.30	29.83	31.24	31.83
CARCASS GRADE (% DOWN)	Early-mated	32	67	52	*
	Mid-season mated	25	51	66	*
	Lated-mated	23	35	51	*
CARCASS GRADE (% DOWN AND FIRST QUALITY)	Early-mated	95	96	100	*
	Mid-season mated	98	95	99	*
	Late-mated	97	88	94	*

*Data not available.

Grading has generally favoured the lambs from the early and mid-season mated flocks, this being due to the disparity in the numbers of lambs from multiple births in the different flocks. There was little difference between the flocks in the number of lambs grading "Down"* and "First Quality", although the two earlier mated flocks have an advantage over the late-mated group.

The high percentage of lambs graded "Down" in 1953 is worthy of note, as this year was marked by poor seasonal conditions and exceptionally slow growth rates. Such results are contrary to the accepted principles of growth, and might he accounted for by a difference in grading standards between years.

The number of carry-over lambs has been highest in the late-mated group and lowest in the early-mated flock. In addition, the standard of pasture management has needed to be of a higher order on the "farm" of the late-mated group. Considerable areas have had to be topped to a height of 4 to 6 in. in the spring to delay the rapid maturity of pastures and to prevent the development of grass seed troubles in the lambs.

The monetary returns from lamb carcasses provided a basis for comparison between the three flocks (Table 6).

*Lamb carcasses for export are graded for quality in the following order: "Down", 1st, 2nd and 3rd quality.

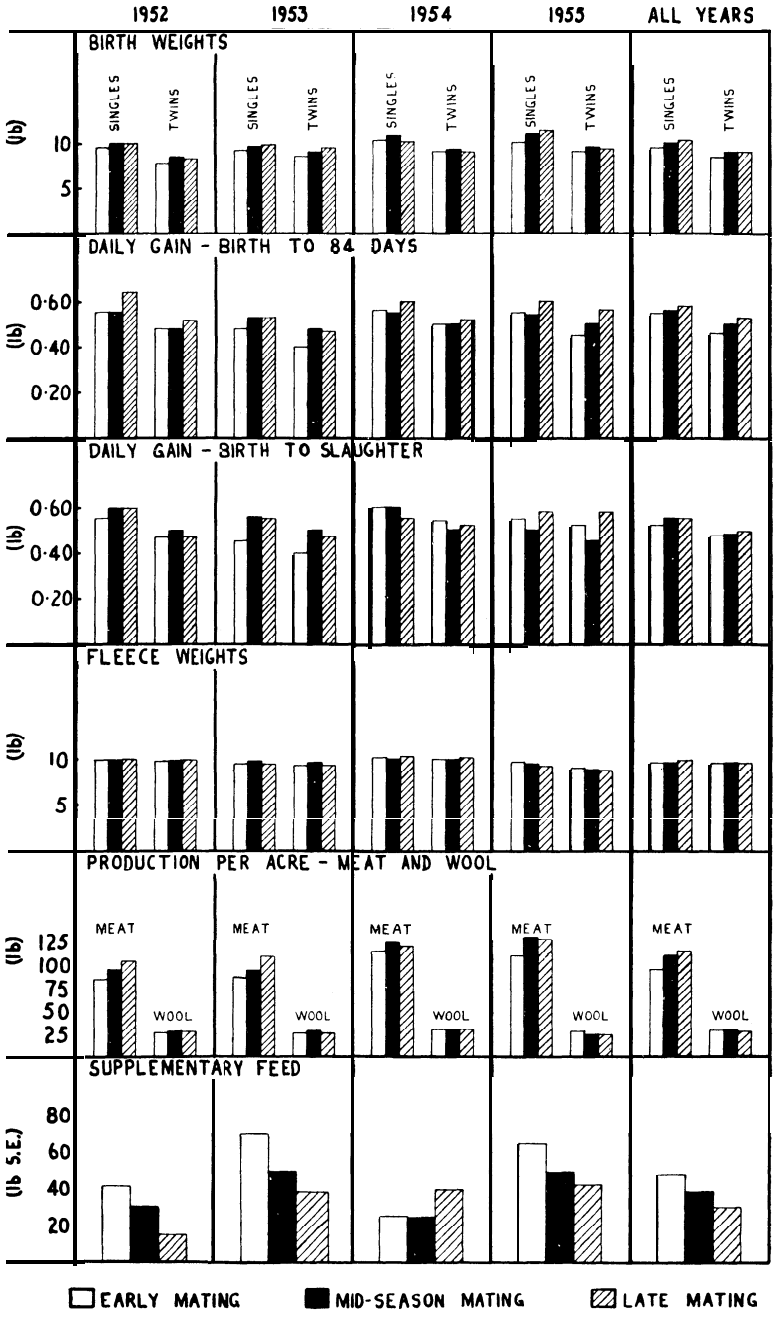

FIGURE 3: Birth weights, growth rates, fleece weights, production per acre of meat and wool, and annual amounts of feed supplements (expressed as Starch Equivalent) consumed, for three flocks.

TABLE 6

	Return for carcasses in year				
	1952	1953	1954	1955	Total
Early-mated	195	249	313	363	1120
Mid-season mated	231	303	346	408	1288
Late-mated	254	340	346	432	1372

(vii) Wool production: Differences in wool production between flocks have been small, although output of lambs has differed greatly. The average wool production of groups for each year, and comparisons of the fleece weights of ewes rearing single lambs with those rearing twin lambs, are shown in Figure 3. With the exception of 1955, the mean fleece weights of ewe classes in the late-mated flock have been heavier than those of the early-mated group.

(viii) Production of meat and wool per acre: Production per acre has favoured the late-mated group, with the mid-season mated flock holding an intermediate position. Returns per acre in terms of wool and meat are shown in Table 7 for the three groups, and are also illustrated in Figure 3.

TABLE 7

	Return per acre							
	1952		1953		1954		1955	
	Meat	Wool	Meat	Wool	Meat	Wool	Meat	Wool
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Early-mated	83	28.5	85.2	27.3	116.5	30.3	115.0	28.4
Mid-season	96.8	29.0	107.0	28.5	127.4	30.1	133.7	28.3
Late-mated	107.1	29.0	117.6	27.0	126.7	30.7	131.2	27.9

Carry-over lambs and skin values have not been included in these data, but in both categories the late-mated group would have had an advantage over the other two flocks.

On the other hand, the potential of the early and mid-season mated flocks to produce lambs dressing out at heavier weights should be recognised, and where markets exist for heavyweight lamb the advantage of the late-mated group would be markedly reduced.

(ix) Supplementary feed: Sheep were supplementary fed with hay or oat grain according to the amount of herbage available for grazing, the stage of pregnancy of the flock, and the general condition of the ewes. Seasonal requirements of flocks have varied, and Figure 3 illustrates the relative quantities of feed, expressed in food units, consumed by the different flocks. The intake of each group is shown in Table 8.

TABLE 8

Group	Annual ewe intake of supplementary feed (lb. S.E.)				
	1952	1953	1954	1955	All years
Early-mated	41.5	70	25	68	51
Mid-season mated	28	53	23	53	39
Late-mated	14	37	39	43	33

The mean figure for all years represents an annual consumption of 146, 112, and 94 lb. of meadow hay per head per year for the early, mid-season and late-mated flocks respectively.

Supplementary feeding has been practised at a much higher level in the early-mated flock than in either of the other two groups. Lambing shortly after the commencement of the autumn rains has resulted in a high grazing pressure at a time when herbage plants are relatively undeveloped, and this appears to have restricted subsequent growth of the pastures.

Fodder in the form of silage has been conserved from equal areas on each "farm" during the flush of the season, and the dry-matter yields of these fodders have been well in excess of supplements fed out to sheep in this trial; thus the carrying capacity of the area does not require to be adjusted for supplementary feed.

(x) Flock wastage: Causes of death or culling in the ewe flock are shown in Table 9. A high incidence of mastitis in the mid-season mated flock in one year only resulted in the wastage in this flock being higher than the other two groups, but this difference cannot be regarded as significant. These results show that high prolificacy in the late-mated group has not increased flock wastage in the period 1 ½-5½ years.

TABLE 9

EWE LOSSES DUE TO MORTALITIES AND CULLING, FROM THE AGES OF 1½ YRS. TO 5½ YRS.

Cause of Death or Reason for Culling	Flock		
	Early-Mated	Mid-Season Mated	Late-Mated
Toxaemia	1	–	1
Febrile condition	1	3	1
Misadventure	1	1	2
Parturition	1	–	1
Tetanus	–	1	–
Mastitis — Death	–	1	–
Culled — Mastitis or other udder condition	2	8	3
Hypocalcaemia	–	1	–
Shearing injury — culled	1	1	–
Unknown	2	–	1

(xi) Seasonal conditions: The numerical expression of seasonal conditions is not possible. The impact of the sum total of all environmental conditions upon the growing animal is best assessed by inspection of the lamb growth data (Figure 3) and the ewe growth and seasonal rainfall diagram (Figure 4).

The effective growing seasons for pastures, taken from the station meteorological records, are shown for each of the 4 years under review:—

Year ($\frac{P}{E} < 0.3$)	Effective growing season for pastures
1952	Mid-April to early November.
1953	Early May to Mid-November.
1954	Mid-April to late October.
1955	Mid-April to late November.

The 1953 season opened later and the 1954 season closed earlier than is normally expected. Above average rainfall was recorded in the years 1953 and 1955, but 1954 was 2½ inches below average. The 1954 season will be remembered for the mild conditions which prevailed during the autumn and winter months, but in the remaining three years these months were typified by the usual cold, wet conditions with little growth of pastures.

DISCUSSION

(i) Lambing percentages: The data show clearly that time of mating has had a profound effect upon prolificacy and fertility in the ewe flock, and must be considered as a controllable agency influencing lamb production.

In this study the nutritional status of the three groups was not controlled at mating time, and it might be considered that the late-mated group received a "flushing" effect from feed at mating time. Table 1 shows the bodyweight status of ewe flocks in the period extending from two weeks before mating to three weeks after the rams had been joined. It will be seen that in 1952 and 1955 the late-mated flock did receive a "flush", but in 1953 and 1954 the liveweight losses over the mating periods were marked. The mid-season mated group received a "flush" following summer rains in 1954, and this gave them

a markedly increased lambing percentage; in fact, the percentage of lambs dropped from ewes which lambed was greater than in the late-mated group.

The effect of "flushing" is well known (Clark, 1934; MacKenzie and Terrill, 1937; Wallace, 1951), and the data presented here indicate that time of mating and "flushing" act independently of one another in their effect upon prolificacy.

However, more detailed study is needed before the full role of each of these controllable agencies can be assessed.

The nature of the physical factors which control changes in prolificacy during the breeding season are also in need of further study. The data of Johansson and Hansson (1943) would suggest that the effects are due to changing length of day. Whether different breeds will respond in the same manner and to the same extent to later mating is also a matter for conjecture. Variations in response would be expected wherever major genetic differences in the capacity to twin exist, and these variations would embrace both level of ovulation and time at which the optimum rate of ovulation could be expected.

The number of dry ewes has also been significantly lower in the late-mated flock than in either of the other two groups, and this increase in fertility, coupled with a higher level of prolificacy, has given very much higher lambing percentages.

Studying the lambing figures by years the general trend towards greater prolificacy with increased age is apparent in the ewe flocks. Such an increase is to be expected as Johansson and Hansson **(loc. cit.)** and many other workers have shown.

To summarize, a difference of 12 weeks in the time of mating between three flocks has led to an almost 50 per cent. greater lamb drop from the late-mated group than from the early-mated group. Although these results will apply to other sheep to a greater or lesser degree depending upon their genetic capacity to twin, there is no doubt that late mating offers a means of profoundly influencing lamb drop and economic return.

(ii) Time of mating and fat lamb production: Successful fat lamb production depends upon a high lambing percentage and an environment suitable for the rapid and sustained growth of the lamb progeny.

Under the Mediterranean environment of South-eastern Australia, lambs are usually dropped to coincide with the onset of the autumn rains, and matings are usually made in December when cross-bred ewes are in the transition period between the non-breeding and the breeding season.

Where the season of effective growth in pastures is of short duration the producer has no latitude for changing the period of mating, but in the higher rainfall areas where the growing season of pastures is longer there is considerable scope for taking advantage of the later mating and at the same time of growing lambs out to good export market weights. In fact, many of the closely settled areas of South-Eastern Australia, where a large proportion of the fat lambs of the Commonwealth are produced, enjoy such an environment.

The effect of time of mating upon production in the particular environment of the lower south east of South Australia has been expressed in the growth and slaughter data given earlier in the paper. It has been shown that when ewes are mated at a date later than the usual December joining, the return per acre in meat and wool is greater, and management problems and supplementary feed consumption in the flocks are reduced.

In the Kybyolite environment later lambing has produced a higher lamb drop with heavier birthweights and faster growth rates, and wool production has not been affected by these factors. However, in the late-mated group the curtailment of the growing season has restricted the weight of lambs marketed and resulted in a small proportion of lambs failing to reach market weight in two years out of four. In a dry year an early close to the season in the spring could be a production hazard, so that where lambs are to be marketed off pastures the mid-season mating is recommended to producers. When fodder crops, or irrigated pasture are available for lamb fattening, late mating should be regarded as the most profitable.

Application to the Merino industry: It is likely that the information in this paper will have some application to the Merino industry, particularly in those areas where improved management methods make it possible to grow pastures, lucerne or fodder crops into the summer months. However, in areas where such practices cannot be adopted the late-dropped Merino is at a disadvantage and does not carry well over the semi-drought conditions of summer.

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DISCUSSION

Dr. WATSON: The variable course of lambing after early mating suggests a year to year variation in sexual activity at the time of joining. Do any confounding variables such as variation in age effect an interpretation that the variation in sexual activity was associated with a variation in environmental conditions?

ANS.: It is difficult to assess the impact of variation in age and feed on the data.

Mr. SCHINCKEL: (1) What was the percentage of twinning in the three groups? (2) Were ewes re-randomised into groups for each year?

ANS.: (1) About 70 per cent. in late mated ewes, 10-20 per cent. in early mated ewes, and 40-50 per cent. in mid-mated ewes. (2) No, they stayed in the respective groups throughout the experiment. We wished to observe whether initial production (lambing, etc.) had any effect on subsequent production.