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The Environmental Factors on the Lamb Growth, Analytically Studied with Extra-Seasonal-Lambs

IV. Wool Growth and the Effects of Environmental Factors

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(Fig. 1–8; Tables 1–7)

Fleece variation is due to complicated interactions of genetical and environmental factors. In order to discuss its variation it may be useful to try first to separate the effects due to heredity, from those due environment. Variations due to environment include such factors as food and seasonal changes in light and temperature, as well as the environment in the proper sense of immediate surrounding of the sheep, such as soil and climate.

TURNER (1956)[1] has defined clean fleece weight in Australian Merino sheep in term of the following components:

$$W = S \times R \times A \times F \text{ (or } K \times L) N \times \rho$$

where W is clean fleece weight. S is smooth body surface area. R is the wrinkling factor. A is the mean fibre cross sectional area. F is mean fibre length. N is mean number of fibres per unit area of skin. ρ is specific gravity of wool.

The wool production of sheep, therefore, may receive an important contribution from the following three components: 1st the number of fibres, 2nd the length of fibres and 3rd the diameter of fibres.

The fundamental differences in the number of fibres on the surface area skin has been found to be limited by follicle population and consequently by follicle growth and development. Although the maximum number of follicles that a lamb will form are determined genetically, many investigations prove that environmental facotrs will affect the follicle population in the early stage after birth (FRASER, 1954[2]; SCHINCKEL, 1955[3]; DONEY and SMITH, 1964[4]; DRAPER *et al.*, 1966[5] etc.)

Wool growth fluctuates according to the varying levels of nutrition and this is observed in the variations in length and diameter of the fibres (RYDER and STEPHENSON, 1968[6]).

Although FRASER (1943)[7] thought that the fibre diameter was more affected by nutritional influences than the fibre length, GALPIN (1948)[8] suggested that the diameter is harmed less by poor nutrition than the length is. But in more recent studies COOP (1953)[9] and RYDER (1956)[10] came to the opinion that length and diameter are affected about equally. FERGUSON *et al.* (1949)[11] found no change in diameter and concluded that the seasonal rhythm was expressed alone in changes of length, where-as COOP, and RYDER, as mentioned above, found that this seasonal change in production was accompanied by changes in length and diameter.

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RYDER insisted on the point that nutrition will affect the overall seasonal effect. But the dominance of purely seasonal effects was demonstrated by COOP (1953)[12], HART (1953)[13], MORRIS (1961)[14] etc. They thought that in the variations of wool production, changes in the length of day are the most important factor.

As above mentioned, photoperiodicity and temperature are pointed out as main factors contributing to seasonal variation in wool production. But there were important contradiction in the different conclusions, i.e. although supported by evidences in which significant variation in wool production had been only responsed to photoperiodic stimuli, COOP (1953)[12], HART (1953)[13], WILDMAN (1957)[15], and MORRIS (1961)[14] mentioned that temperature did not modify the seasonal rhythm in wool production, FERGUSON *et al.* (1949)[11] described that seasonal effects appeared also to be associated with seasonal changes in temperature and WILDMAN, also in fact, suggested that, it was probable that variation in temperature was a contributory factor.

In more recent years BENNTTT, HUTCHINSON and WODZICKA-TOMASZEWSKA (1962)[16], DONEY and GRIFFITHS (1967)[17], DOWNES and HUTCHINSON (1969)[18], LYNE *et al.* (1970)[19] have proven again that ambient temperature can modify the annual rhythm on exposed patches of skin. On the other hand HART *et al.* (1963)[20], HUTCHINSON (1965)[21] have introduced a new modifier, light intensity, into seasonal variation of wool production.

As a result of his earlier researches on wool growth of Corriedale lambs in Japan MIMURA (1956)[22] has shown the evidence of seasonal rhythm in wool growth as being evidently in length and not in diameter as FERGUSON *et al.* (1949)[11] had proven, showing the greatest of diameter in the 3rd month after birth and the smallest in the 9th month. He reported moreover that the number of fibres per unit area had become the highest within the 3rd month to the 9th month after birth proving clearly that nutritive conditions had an influence on fleece development.

Although there are many investigations, as above mentioned, on the components affecting growth and seasonal variation in wool fibres, it is not to show these in full details in the changes of wool production during the growing of lambs. A general description on the seasonal variation of wool growth can not be considered as a complete explanation, because the period of the year in which the ewes are lambing is mainly restricted to spring and therefore it will be difficult to separate seasonal rhythm from wool growth pattern resulting from the growth, development and maturity of wool follicles more or less modified by environmental factors. This will be certain only, when growth pattern and environmental factors have been examined analytically on lambs produced all over a year.

In the previous papers on this subject, the authors (MIMURA and ASAHIDA, 1959[23]; MIMURA *et al.*, 1964[24]) reported that twenty-seven lambs were produced under treatment, outside the normal lambing season. These were kept under observation from 1957 to 1963. The authors could also dicussed the growth and development of extra-seasonal lambs, compared with an other eight lambs produced normally (MIMURA and ASAHIDA, 1971[25]).

In the present paper the authors intend to give a report on wool growth and development, as related to the growth pattern of wool fibres on the surface skin of the lambs that have been investigated together with the lambs described in their previous paper.

MATERIALS AND METHODS

The lambs under investigation are the same ones as those described in detail in Table 1 of the previous paper (MIMURA and ASAHIDA, 1971)[25]. After birth, four marks were made on the skin of the lambs, of about one cm square, with indian ink. The mid-side position had been chosen for tattooing as representative for the best average position of fleece characteristics (BURNS, 1935[26]; CARTER, 1943[27]; MIMURA, 1956[22]).

The skin areas were calculated from the measurements of diagonals and distances between marks by the Helon's equation which was done twice on the day and next day after the clipping of fibres at the birth, the first month, the third month, the fourth month, the sixth month, the nineth month and the twelfth month. But measurements were not made after the sixth month for ram lambs as described in previous paper. Then skin areas were expressed as skin expansion ratio during the growing of lambs.

Clean wool weight, number of fibres and fibre diameter were measured by estab-, lished methods from the fleece samples clipped (see RYDER and STEPHENSON, 1968[6]). Such fibres were excluded from the measurement of fibre diameter, as halo-hair type, super-sickle type and sickle type (STEPHENSON, 1956[28]).

RESULTS

1. *Skin expansion ratio*

Skin expansion ratio as presented in the previous paper, and the average increasing rate of growth per month are shown in Table 1.

Table 1. The average increasing rate of skin expansion per month (in percentage).

Group	Age in month					
	0–1	1–3	3–4	4–6	6–9	9–12
Spring ewe lambs	98	75	69	29	3	0
Early summer ewe lambs	75	84	3	1	35	31
Autumn ewe lambs	179	95	51	69	26	14
Winter ewe lambs	50	66	58	7	20	− 2
Spring ram lambs	86	85	81	26		
Early summer ram lambs	75	83	35	22		
Summer ram lambs	84	53	107	1		
Autumn ram lambs	151	86	51	27		
Winter ram lambs	115	75	71	21		

Remark: Differences within ages and within seasons are significant ($P<0.01$).

The authors showed in their previous paper that there is a significant correlation between the expansion ratio and the growth in live weight, although expansion ratio changed during the growing period of lambs on a large scale than that of growth and had a different significance from the growth in the skin area of lambs.

2. *Clean fleece weight per unit area*

The variation of fleece weight per unit area on the tattooed part is shown in Table 2

Table 2. The changing of average clean fleece weight produced on the part tattooed per day per cm^2 (in percentage).

Group	Age in month					
	0–1	1–3	3–4	4–6	6–9	9–12
Spring ewe lambs	(1.55)	98	107	100	64	50
Early summer ewe lambs	(1.79)	84	101	74	49	72
Autumn ewe lambs	(1.40)	126	180	160	143	127
Winter ewe lambs	(1.85)	101	121	82	91	62
Spring ram lambs	(1.58)	84	101	74		
Early summer ram lambs	(1.45)	90	95	82		
Summer ram lambs	(1.26)	102	81	61		
Autumn ram lambs	(1.58)	133	96	86		
Winter ram lambs	(1.30)	130	178	129		

Remarks: 1) Clean fleece weight per day per cm^2 is expressed as wool production, and percentage is calculated as compared with the weight at the 1^{st} month (0–1 month).

2) Figures in parentheses express the average weight at the 1^{st} month produced during 0–1 month ($mg/day/cm^2$).

3) Differences within seasons are significant ($P<0.01$), and differences within ages are also significant ($P<0.05$).

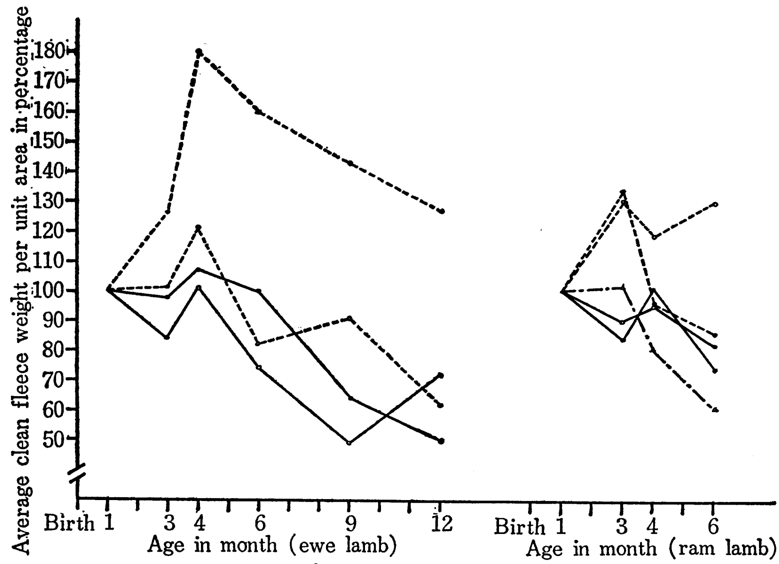

Fig. 1. The change along the growing of lambs, in percentage, of the average clean fleece weight per unit area.

●—●: Spring lambs, ○—○: Early summer lambs

△-•-△: Summer ram lambs, ●···●: Autumn lambs

○···○: Winter lambs

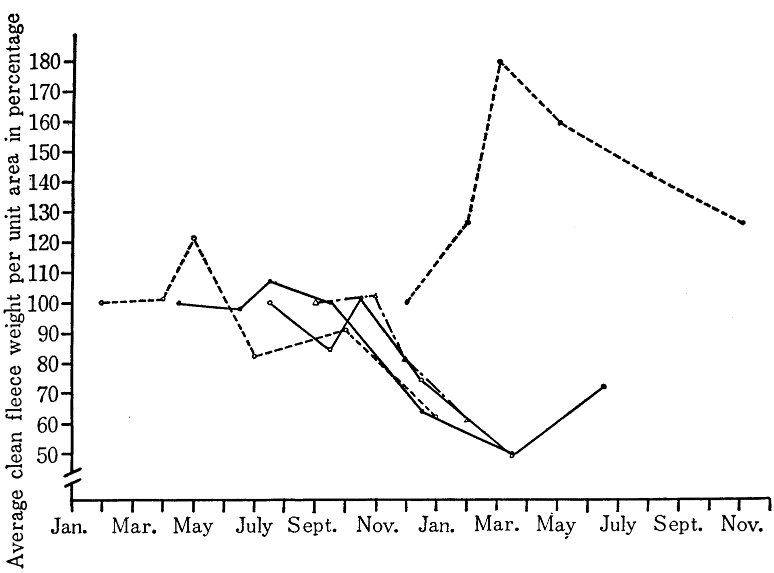

Fig. 2. The change along months, in percentage, of average clean fleece weight per unit area.

●—●: Spring lambs, ○—○: Early summer lambs
△-•-△: Summer ram lambs, ●···●: Autumn lambs
○···○: Winter lambs

and on Fig. 1. In order to indicate seasonal effects clearly the result is visualized on Fig. 2 sliding on each month measured during the growing period of lambs.

As shown on Fig. 1 the highest production occured at the 4th month for ewe lambs, i.e. within the 3rd month to the 4th month; and in the 3rd month or 4th month for ram lambs.

It is interesting to notice that the peaks of production observed, under spring conditions at the fourth month in the group lambing in autumn and winter; on the contrary, that declining tendency observed under summer conditions in the autumn group and under winter conditions for the early-summer group were very different in appearance.

Although the wool production of the investigated lambs was conditioned by the surface area, the fibre length, the number of fibre and their diameter as described by TURNER (1956)[1], the results were not completely in accordance with those conditions. This proved that the wool production of lambs during the growing had to be considered as including still other factors. This result will be discussed afterward.

The average wool production of lambs investigated, 1.55 mg/day /cm^2 for female, was greater than 1.06 mg/day/cm^2 of lambs reported by MIMURA (1956)[22].

3. *The number of fibres on surface skin*

The change of the average number of fibres grown on the surface skin is shown in Table 3 and on Figs. 3–4. The same increasing tendencies were visible in all groups from birth until the 6th or the 9th month, yet a decreasing tendency was also remarkable after the 6th month in early-summer lambs.

Rapid increasings were observed within birth to the 3rd month for spring lambs,

Table 3. The changing of the average number of fibres grown on surface skin area of lambs (in percentage).

Group	Age in month						
	Birth	1	3	4	6	9	12
Spring ewe lambs	100	180	355	327	387	417	394
Early summer ewe lambs	100	167	215	234	391	278	226
Autumn ewe lambs	100	196	337	493	503	515	529
Winter ewe lambs	100	176	290	310	308	349	356
Spring ram lambs	100	186	303	318	332		
Early summer ram labms	100	207	289	357	386		
Summer ram lambs	100	170	248	284	277		
Autumn ram lambs	100	243	439	453	408		
Winter ram lambs	100	204	258	250	240		

Remarks: 1) The number of fibres is measured on the part which was tattooeed on the right mid-side of lambs.

2) Differences within seasons and within ages are significant ($P<0.01$).

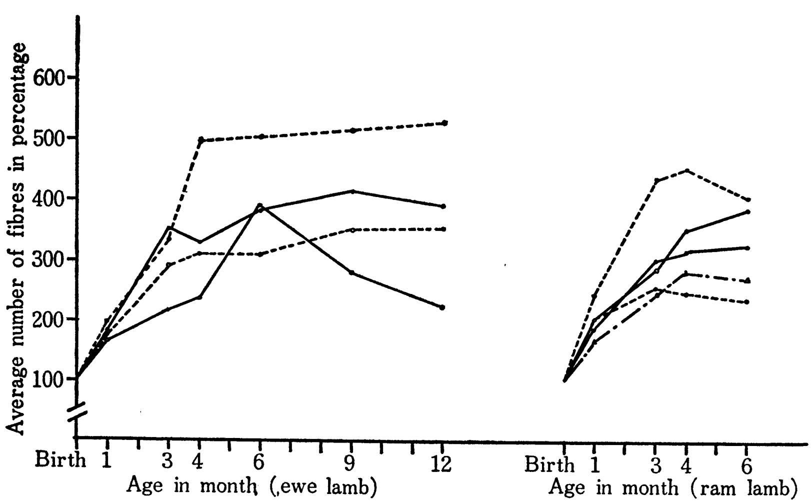

Fig. 3. The change along the growing of lambs, in percentage, of average number of fibres grown up on the part tattooed.

●—●: Spring lambs, ○—○: Early summer lambs

△-•-△: Summer ram lambs, ●···●: Autumn lambs

○···○: Winter lambs

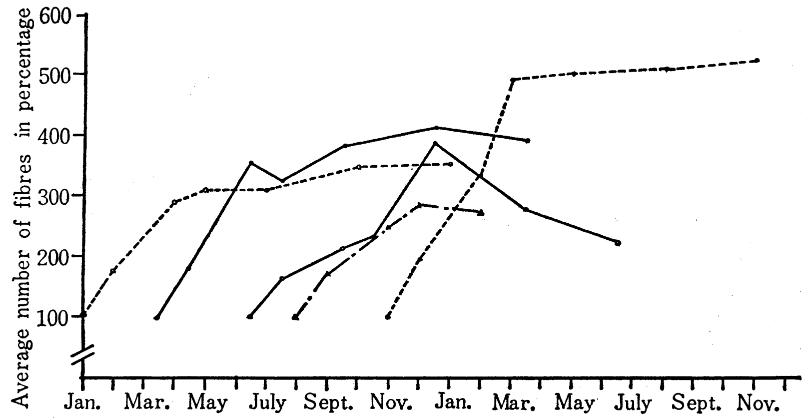

Fig. 4. The change along months, in percentage, of average number of fibres grown up on the part tattooed.

●—●: Spring lambs, ○—○: Early summer lambs
△-•-△: Summer ram lambs ●···●: Autumn lambs
○···○: Winter lambs

winter lambs and summer lambs; within birth to the 4th month for autumn lambs; and within the 4th to the 6th months for early summer lambs. It was, therefore, recognized that the rapid increasing periods happened under early spring and autumn conditions.

The change of average number of fibres per unit area (wool fibre density) is shown in Table 4 and on Figs. 5–6.

Although MIMURA (1956)[22] has reported the progressive decreasing wool fibre density during the growing up of lambs, there showed different tendencies in winter lambs whose number of fibres per unit area increased from birth to the 1st month and then turned to decreasing rate. The slight increasing rate within the 1st to the 3rd

Table 4. The changing of the average number of fibres per unit surface skin area of lambs (in percentage).

Group	Age in month						
	Birth	1	3	4	6	9	12
Spring ewe lambs	(4,340)	91	97	78	77	82	76
Early summer ewe lambs	(5,385)	96	71	82	77	68	44
Autumn ewe lambs	(3,719)	67	72	96	84	70	69
Winter ewe lambs	(3,071)	121	94	93	82	87	88
Spring ram lambs	(4,505)	108	83	73	67		
Early summer ram lambs	(3,024)	118	91	95	93		
Summer ram lambs	(4,225)	100	94	79	78		
Autumn ram lambs	(4,511)	96	104	95	78		
Winter ram lambs	(3,198)	127	82	65	60		

Remarks: 1) The calculating of percentage is the same as in Table 2.
2) Figures in parentheses express the average number per unit area (cm^2) at the birth.
3) Differences within seasons and within ages are significant ($P<0.05$).

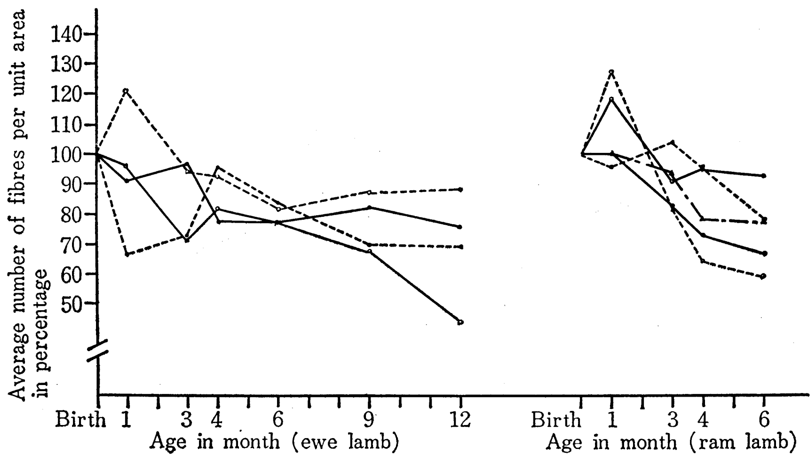

Fig. 5. The change along the growing of lambs, in percentage, of average number of fibres per unit area.

●—●: Spring lambs, ○—○: Early summer lambs
△-•-△: Summer ram lambs, ●···●: Autumn lambs
●—●: Winter lambs

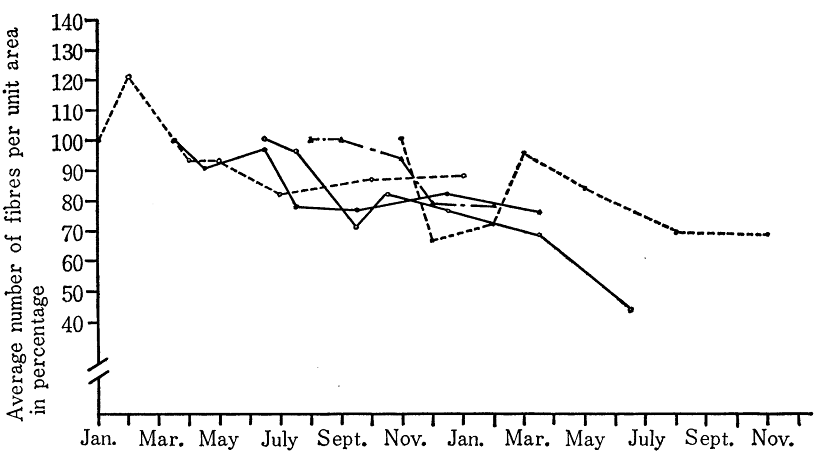

Fig. 6. The change along months, in percentage, of average number of fibres per unit area.

●—●: Spring lambs, ○—○: Early summer lambs
△-•-△: Summer ram lambs, ●···●: Autumn lambs
○···○: Winter lambs

months for autumn lambs and within birth to the 1^{st} month for early-summer lambs may probably ignored, yet it is important to notice that these facts point to the same tendencies in the increasing number of fibres on surface skin. As the relations between these facts and skin expansion ratios are intricate to interprete, they will be discussed afterward.

The average numbers per unit area were reported by MIMURA (1956)[22] as 2748 in

1952 and 3209 in 1953 respectively, therefore the present result in spring lambs, 4340, is a little greater than that.

4. *Diameter of fibres*

The change in the average diameter of fibres during the growing of the lambs is shown in Table 5 and on Figs. 7–8. The halo-hair type, super-sickle type and sickle

Table 5. The changing of the average diameter of fibres (in percentage).

Group	Age in month						
	Birth	1	3	4	6	9	12
Spring ewe lambs	(20.8)	128	136	136	122	125	126
Early summer ewe lambs	(20.7)	113	125	121	115	133	146
Autumn ewe lambs	(19.1)	146	147	157	158	157	160
Winter ewe lambs	(20.8)	136	143	148	141	152	127
Spring ram lambs	(20.2)	132	140	150	133		
Early summer ram lambs	(22.1)	116	134	126	118		
Summer ram lambs	(20.2)	125	128	124	115		
Autumn ram lambs	(20.9)	129	133	132	129		
Winter ram lambs	(20.9)	114	142	153	141		

Remarks: 1) The calculating of percentage is the same as in Table 1.
2) Figures in parentheses express the average size of wool fibres at the birth in which hairy fibres are excluded from the measuring (unit: μ).
3) Differences within seasons and within ages are significant ($P<0.01$).

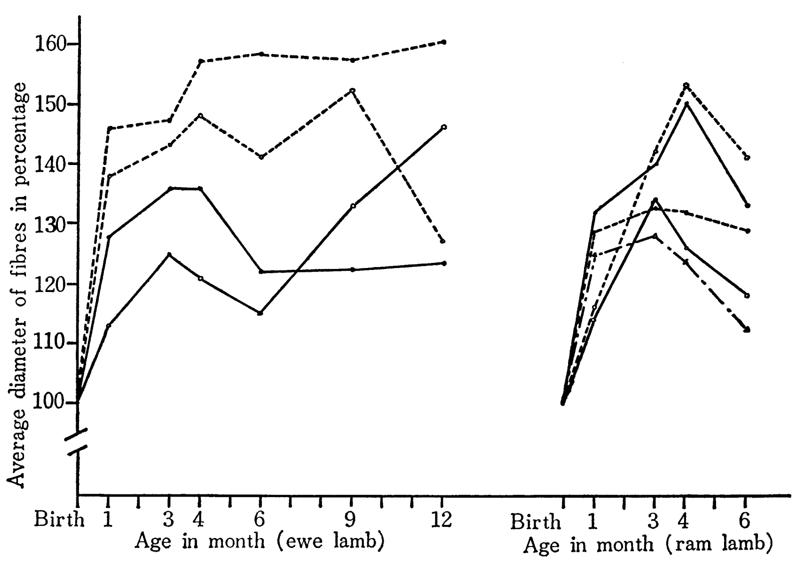

Fig. 7. The change along the growing of lambs, in percentage, of average diameter of fibres grown up on the part tattooed.

●—● : Spring lambs, ○—○ : Early summer lambs

△-•-△ : Summer ram lambs, ●···● : Autumn lambs

○···○ : Winter lambs

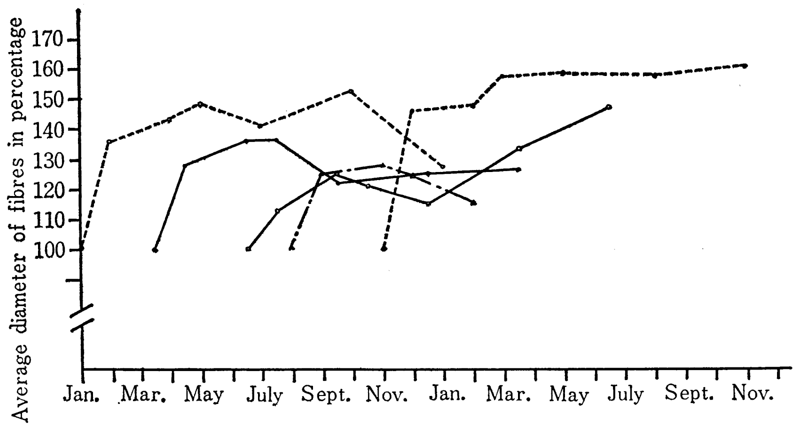

Fig. 8. The change along months, in percentage, of average diameter of fibres grown up on the part tattooed.

●—● : Spring lambs, ○—○ : Early summer lambs
△-•-△ : Summer ram lambs, ●···● : Autumn lambs
○···○ : Winter lambs

type fibres which grew in the pre-natal period from primary follicles were excluded from the result, therefore the changes were considered to be mainly due to fibres grown from secondary follicles.

From the results, increasing in size from birth to the 3rd or the 4th month and declining in size from the 4th month to the 6th month were obserbed. The growth of fibres in diameter and length at the early stage after birth could be attributed to the post-natal maturity of follicles correlated to the high expansion rate of skin, because high rate in autumn lambs proved to be in accordance with their high expansion ratios of skin.

It is very interesting to notice that the result of spring lambs was in accordance with the one given by MIMURA (1956)[22] in which fibre diameter was shown to be greatest in the 3rd month, although the tendencies in other groups were different. The facts will probably show the seasonal effects on the growth of fibre diameter.

Comparing the declining rate in winter lambs to the increasing rate in early-summer lambs both in the 12th month, differences in results will probably be due to the changes in expansion ratio of skin area in which the former declined from 412% to 407% against from 412% to 512% in the latter from the 9th month to 12th month respectively.

The average diameter of fibres at the birth in spring ewe lambs, 20.8 μ, were smaller than that of lambs investigated by MIMURA (1956)[22] which was reported as 29.1 μ in 1952, 29.7 μ in 1953.

DISCUSSION

1. *The growth and development of fibres on surface skin*

Although the change of wool production during the growing of lambs is due to complicated interactions of genetical and environmental factors, it may be mainly attributed to various components, such as surface skin area, fibre growth in length and diameter, and fibre number as suggested by TURNER (1956)[1], DALY and CARTER (1956)[29] etc.

The present results in which the highest production per unit area were shown at the 4th month for ewe lambs and in the 3rd and the 4th months for ram lambs, may be also considered for this reason from the view point of the interaction of these components. As the measurement of fibre length did not try, to our regret, in the present investigations, the change in the percentage of wool growth in length per day was assumed from the clean fleece weight, fibre diameter and fibre number in the Turner's equation as described above. It is visualized in Table 6.

Table 6. The changing of average growth in length per day presumed from clean fleece weight, wool number and wool diameter (in percentage).

Group	Age in month					
	0–1	1–3	3–4	4–6	6–9	9–12
Spring ewe lambs	100	85	116	132	73	63
Early summer ewe lambs	100	94	103	89	51	94
Autumn ewe lambs	100	125	133	144	143	128
Winter ewe lambs	100	120	67	111	101	94

Remark: Differences within seasons are significant ($P<0.05$), but differences within ages are not significant.

The wool production per unit area, theoritically, may be positive in correlation with the growth of fibres in length and diameter correlated negatively with wool density, but it must be noticed on the other hand, that wool density in growing lambs may change basically in the complex relation between skin growth and fibre number.

The average monthly skin growth is shown in Table 1 and the average rate of monthly increasing fibres is shown in Table 7 recalculating from the Table 3 in present paper. The data suggested that rates for autumn lambs were remarkable high within the 3rd to the 4th months, although in other groups they were not always higher than that in other months of age. Therefore, it may be concluded that the highest production for autumn lambs were particulaly attributed to the high growth rate of skin expansion, fibre diameter and fibre length within the 3rd to the 4th months. The highest in other groups which occured within the same age-periods would be difficult to determine for the same reason. For example, the result in spring and early-summer lambs may considered as due mainly to the high growth rate in length and diameter, but the same tendency in winter lambs would not occur except for the increase in diameter.

Table 7. The increasing rate of number of fibres per month grown on surface skin (in percentage).

Group	Age in month					
	0–1	1–3	3–4	4–6	6–9	9–12
Spring ewe lambs	80	88	−28	30	10	−8
Early summer ewe lambs	67	24	19	79	−38	−17
Autumn ewe lambs	96	71	156	5	4	5
Winter ewe lambs	76	57	20	−1	14	2

It is very important to notice that all components except wool density show increasing phases during the early stage after birth in response to the rapid growth and development of lambs, and that the wool production per unit area may be also in the same line (see Fig. 1).

2. *Seasonal effects on wool growth*

Although it is recognized by many reseachers (FRSER, 1954[2]; RYDER, 1955[30]; Schinckel, 1955[3]; Stephenson, 1958[31] etc.) that almost all follicles initiated before birth, Short (1955)[32] and Wildman (1956)[33] have suggested that environmental effects exert great influence over the mature secondary follicles population in early postnatal life. Present results indicate that most fibres grew up from follicles on surface skin within the 3rd or 4th months after birth, and that fibres then had been increasing or carrying on, on the same level in accordance to the results of MIMURA (1956)[22] and SUGAI (1953)[34] in which on Japanese Corriedale lambs the fleece can be considered established within the 6th month after birth.

Rapid increasing after the 6th month in early-summer lambs made a exception, yet it can hardly to be condidered as due to seasonal variation. The low rate in general might be explained by early-summer, summer and early-autumn conditions during the early stage of growth.

The highest rate of number per unit area was shown in winter lambs at the 1st month, then rapid decreasing rate was noticeable from birth to the 3rd month in autumn ewe lambs. Although the former were under winter condition alone while the latter under autumn and winter conditions, the results may be attributed to different factors, i. e. the former might have been about the lowest rate of skin expansion accompanied with a comparatively low rate of fibre number, while the latter might have been due mainly to the highest rate of skin expansion (see Table 1, Fig. 3).

The growth in length and diameter are always influenced by environmental factors as confirmed by many researchers (FRASER, 1934[7]; COOP, 1953[9]; RYDER, 1956[10]; DALY and CARTER, 1956[29]). For example, the winter narrowing of wool fibres, poor growth in diameter and length in cold season or in drought season have been pointed out as an important problem by wool growers. From the present results the following tendencies also emerge; poor size was remarkable in early-summer lambs within the 4th ot 6th months under autumn conditions, and for winter lambs within the 9th to 12th months under witer condition.

In recent works LYNE, JOLLY and HOLLIS (1970)[19] and JOLLY and LYNE (1970)[35] investigated on the effects of subdermal temperature on wool growth employing heat-exchange chambers, these suggested that cooling of the skin had little effect on fibre diameter, while reduction in subdermal temperature produced a progressive reduction in length growth rate.

The summer and early-summer seasons in Japan, especially in the west districts, are the worst seasons for nutritional conditions; suffering from severe hot weather, followed by winter with poor nutritional conditions. Therefore, it was also decided to observed the declining tendency in fibre diameter under summer conditions. But the present results were different from those of increase in live weight gains. The actual result suggest that decline in fibre diameter should be attributed to shortness of winter day light and poor nutrition rather than to the cold temperature in these seasons as was suggested by WILDMAN (1957)[15]. The fact in all groups that fibre diameter changed principally with the same tendencies during the early stage of growth is very important. The reasons why seasonal effects do not change the general pattern of the change of fibre diameter in early stage may be the activity of endogenous unknown facors, milk supply and others that may neutralize the activity of environmental factors, as described by the authors in previous paper.

SUMMARY

It is not easy to show in full details the changes in wool production during the growing of lambs, mainly because the period of the year in which ewes will be lambing is mostly restricted to spring, consequently it will be difficult to separate seasonal rhythm from the original pattern of wool growth.

In order to solve the problem the authors took twenty-seven lambs produced outside the normal lambing season from 1957 to 1960. And these twenty-one lambs together with eight lambs produced under normal condition were reared from birth to the twelfth month for female and from birth to sixth month for male, during the years 1957–1963 in order to investigate analytically the growth pattern and environmental effects.

In sequence to the previous paper the authors report here now on wool growth and seasonal effects during the growing of lambs.

Rapid increasing rates of number of fibre follicles on surface skin were observed within birth to the 3rd month in spring lambs, summer lambs and winter lambs; within birth to the 4th month in autumn lambs; and within the 4th to the 6th months in early-summer lambs. It was recognized that the most rapidly incressing periods were under early spring and autumn conditions. Wool density in winter lambs increased from birth to the 1st month differing from tendencies in other groups and the fact which Mimura has reported the progressive decreasing along the growing of lambs. On the variation, in general, of average fibre diameter increasing size from birth to the 3rd or the 4th months and declining tendencies from the 4th month to the 6th month were noticed. Especially poor sizes were remarkable in early-summer lambs within the 4th to the 6th months under autumn condition and in winter lambs within the 9th to the 12th months under winter condition. Therefore, the authors suggest that decline in fibre diameter may be attributed to day-shortness and poor nutrition rather than cold temperature under autumn and winter condition.

It is very important to suggest that all components affecting wool production are increasing phases, in exception with wool density, during early stage after birth responsing to the rapid growth and development of lambs.

In all groups the highest clean wool production per unit area occured within the 3rd to the 4th months. Although the highest production in autumn lambs was synthetically attributed to the high growth rates in skin expansion, fibre diameter and fibre length within the ages, those in other groups might be attributed not only to one or two components which could be interaction of various components upon each other.

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季節外生産羊を利用しためん羊発育に及ぼす環境要因の解析的研究

IV. 羊毛の成長と環境要因の影響

三村　耕・朝日田康司

21頭の季節外生産羊と8頭の正常羊とを1957年～1963年発育試験し，生後1カ年（雌），半カ年（雄）における子羊発育のパターンとこれに及ぼす季節の影響については前報に報告した．これと同時に実施した羊毛の成長とこれに及ぼす環境要因の影響に関する成果を本報で報告する．

1. 右 mid-side に 1 cm 角に入墨した皮膚面より刈取った洗上げ羊毛重量の変化をみると，いずれも生後3～4月間に最高を示した．また春季に急増し，秋・冬季に減少の傾向のみられたことも興味深い．羊毛生産量は特に皮膚面積，長さと太さおよび，繊維数の函数と認められるが，子羊の発育初期においては，密度は当然減少するが，その他は全て増加の相（BRODY の self-accelarating phase）にあると考えられ，冬季生産羊の羊毛成長の変化はこのことを明瞭に示している．

2. 同上部位に成長した繊維数は全て3月令までに急速に増加し，以降そのレベルを維持するか増加したが，初夏生産羊では6月令以降すなわち冬～春季にかけ急減した．

3. 単位皮膚面積当り繊維数は，三村（1956）と同様減次減少するが，冬季生産羊では1月令に生時より大となった．羊毛密度は皮膚面積増大率と繊維数増加の両面から検討を要するであろう．

4. 繊維の太さの変化は，一般に3，4月令まで増大，4～6月令に細くなる傾向が認められた．LYNE ら（1970）は，暑さは太さを減じるが寒さは太さを減じないと報告している．結果は秋～冬季に繊維の太さを減じる傾向が認められた．わが国西南暖地の冬季の寒さはきびしくないから，この事実は短日と栄養状態の低下に帰因することを暗示している．

ERRATUM

Vol. 10, No. 1 p. 35 Fig. 5 Explanation

●—●: No. 59–2 → ●—●: No. 57–2

Vol. 10, No. 1 p. 37 Table 4 *l*. 6

Winter lambs 100 150 181 301

↓

Winter lambs 100 150 181 339