

THE INFLUENCE OF SEASON ON YIELD INCREASE AND LACTATION YIELD IN THE AYRSHIRE HERD OF VIK EXPERIMENTAL FARM

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The lactation yield and thus also the milk production curve are affected by genetic as well as environmental factors. Among the environmental factors feeding, calving interval, age, and number of calving, and, according to several authors, the dry period preceding the calving and following the lactation, are the most important (LONKA 1943, p. 15). SANDERS (1927—28) and JOHANSSON and HANSSON (1940) among others have thoroughly investigated the influence of these factors on the milk production curve. According to LONKA (1943, p. 15), the most important of the environmental factors is undoubtedly the difference in feeding between different herds and seasons. The influence of the season of calving, or more specifically of the month of calving, constitutes part of this.

To a great extent the influence of the season of calving, or more exactly of the month of calving, depends on the climatic conditions of the country. The quality of the indoor and winter feeding furthermore varies greatly also in the same country and even on different farms located in the same area (TERHO 1939, p. 37, LONKA 1943, p. 20). If the environmental conditions are favourable throughout the year, the influence of the season on the yield is negligible (JOHANSSON and HANSSON 1940, p. 120). Earlier in Finland the summer feeding used to be good compared to the poor winter feeding; thus the cows calving in the summer gave the best yields. When the indoor feeding later improved, especially the cows freshening in the autumn gave better yields than those calving during the pasture season (LONKA 1943, p. 21). Already in the 1920's the lactation yields of autumn calving cows in Finland, according to BRUUN (1928, p. 35), were generally higher than those of spring calving cows.

Investigations carried out in various countries have shown the lactation yields of autumn calving cows to be higher than those of cows calving in spring or summer (JOHANSSON and HANSSON 1940, p. 120, LONKA 1943, p. 21, AURIOL 1955, p. 192,

CANNON 1933, p. 11). JOHANSSON and HANSSON (1940, p. 120) have in Sweden observed that besides autumn calving also winter calving is favourable. Similarly LAKSVELA et al. (1952) have observed that both autumn and winter calving (Sept.-Feb.) cows give the highest annual yields and at the same time the best return per food unit home grown roughage. The authors, however, consider the smaller consumption of concentrates ($\frac{2}{3}$ of the consumption of the autumn calving cows) and the greater utilization of pasture grass to be in favour of the spring calving cows. The investigation was carried out in Norway on a farm with intensive indoor feeding and where the pastures were in good condition. In England, according to SANDERS (1927, p. 353), the month of calving influences the lactation yield very little. Generally the yields of the autumn calving cows are, however, the highest because of the favourable form of the milk production curve. According to LONKA (1943, p. 53), the month of calving influences the yields of mature cows least and the two first lactations most.

Material and methods

The present paper examines the influence of season on the following characteristics of the Ayrshire herd of the University Farm Viik in Helsinki: the maximum daily production (peak production), the duration of the ascending phase (period from freshening to peak of lactation), the persistency of lactation, the 12-month production, and the live weight. The material was collected from cows calving in the years 1950—1965. In 1950 intensively cultivated pastures were laid down in Viik, the harvest of which yielded some 4000 food units per hectare. At the same time the indoor feeding was very intensive, satisfying all the nutritional requirements of the cows. The size of the herd varied between 60 and 70 cows. The cows were divided into 3 groups according to season of calving: 1) spring calving cows, whose whole ascending phase occurred between Jan. 1st and end of the indoor feeding period, 2) cows calving during the pasture season, whose ascending phase fell within the pasture period, and 3) autumn calving cows, who freshened between the beginning of the indoor feeding period and Dec. 31st. As a consequence of this grouping, several cows calving during the end of the indoor feeding period or the pasture season were not included in the analyzed material.

The peak of lactation is usually expressed as an average of several days. KAJANOJA and SILVENNOINEN—LARPES (1959, p. 336) have selected the average of the best four consecutive days as a measure of the maximum daily production, and the second of these four days as the peak. DECAEN and POUTOUS (1965, p. 136) estimated the peak of lactation as the average of the best five days, the duration of the ascending phase being the time from freshening to the third of these days. In the present paper the peak of lactation is considered to be the average of the three best consecutive days, provided, however, that the production of the central day is as high as or higher than the production of the preceding and the following day. The peak of lactation is regarded to be reached on the central of these days. The duration of the ascending phase is the time from calving to the day of peak production, considering the day of freshening as day zero. If a cow reaches an

equally high peak of lactation several times, the ascending phase is regarded as completed with the first of these peaks. As a measurement of the rapidity of yield increase the yield increase tangent was chosen. The tangent gives the relation of the peak of lactation to the duration of the ascending phase (kg/days). The material necessary for the analysis of the yield increase of the cow was collected by weighing the milk daily until the day of peak production was well passed.

Several methods for expressing the persistency of lactation have been developed. TERHO (1939, p. 43) considered the production of the 5 best consecutive months expressed as a percentage of the lactation yield as a measure of the persistency. AURIOL (1955, p. 195) uses the so called C.P.M.-value, which is an average of the yields for one month and the month preceding it given as relative values of the production during the lactation. BRUUN (1928, p. 24) compares the monthly values of the actual production curve with the corresponding horizontal values of the so called ideal curve. JOHANSSON and HANSSON (1940, p. 83) consider the so called $P_{2:1}$ - and $P_{3:1}$ -values and the length of the dry period following the lactation as equally good measures of persistency. Of these the $P_{2:1}$ -value, i.e. the production of the second 100 day period of the lactation expressed as a percentage of the production of the first 100 day period, has been widely used. Besides by JOHANSSON and HANSSON it is used by FUHRKEN (1959, p. 322) and BLAU (1961, p. 381) among others. Also in the present investigation the $P_{2:1}$ -value is used as a measure of the persistency of lactation. It was estimated by calculating the sum of the test milkings 11—20 in per cent. of the sum of the test milkings 1—10 (average interval between milk testings is 10 days). In general the lactation yield is considered a better measurement of milk production than the yield of the recording year, when the effect of the environmental influences are investigated (LONKA 1943, p. 49, BRUUN 1928, p. 24). In order to eliminate the influence of the service period, only part of the lactation yield is often used. For example JOHANSSON and HANSSON (1940, p. 54) use the first 200 or 300 days of the lactation, BLAU (1961, p. 381) the first 300 days, LENNON and MIXNER (1958, pp. 969—976) the first 240 days (reported as 4 % milk) and FUHRKEN (1959) the first 200 days of the lactation. According to SANDERS (1927, p. 514) the pregnancy dries the cow off slowly in the beginning, but very quickly 20 weeks after the pregnancy started. See also PALOHEIMO and HASUNEN (1964, p. 263).

In the present paper the 12 month production was used because of its close resemblance with the yield of the recording year. Only cows in calf within 6 months from freshening and being healthy enough were, however, included in the material. The same material was used for calculating the persistency values. Altogether this material covers 547 cases. The material concerning the ascending phase is larger, consisting of 680 cases, because only the cows affected by diseases influencing the increase of production were excluded (MÄKELÄ 1963). Excluded from both materials were all cows that on account of low production had been culled already during their first lactation. The statistical test used was a one way analysis of variance (BONNIER and TEDIN 1940, p. 40). The increase of milk yield of the cows in the Viik herd has earlier been subjected to statistical analysis by KAJANOJA and SILVENNÖINEN-LARPES (1959) and by MÄKELÄ (1962).

Results

Table 1 gives the influence of season on the ascending phase of lactation, the persistency of lactation, the 12 month production, and on the live weight of cows of different age groups during different seasons. The influence of season on the peak production is highly significant in all age groups ($P < 0.0005$). During the pasture season the peak production of first lactating cows is on an average about 2 kg and of cows in later lactations about 3.5 kg less than during the indoor

Table 1. The influence of season on the yield increase, persistency of lactation, 12 month lactation yield, and live weight of cows (Averages).

Season of calving	Peak production kg	Duration of ascending phase days	Yield increase tangent kg/day	Persistency of lactation P _{2:1} %	12 month lactation yield kg	Live weight ¹⁾ kg
First lactations						
Spring	19.4	45	0.48	81.6	4 488	460
Pasture season	17.1	36	0.55	91.3	4 390	442
Autumn	19.7	46	0.49	90.0	4 864	461
Second lactations						
Spring	25.6	36	0.82	70.1	4 792	506
Pasture season	22.1	28	0.90	81.5	4 883	465
Autumn	25.5	36	0.80	77.4	5 258	502
Third and later lactations						
Spring	27.8	36	0.88	71.1	5 301	543
Pasture season	24.2	33	0.84	78.6	5 146	519
Autumn	27.5	41	0.79	82.0	5 857	536

¹ One week after calving.

feeding period. On the other hand the peak production of spring and autumn calving cows is approximately the same. DECAEN and POUTOUS (1965, p. 135) using data on Brown Swiss cattle in France, have observed that the peak production is the lowest for cows calving during summer, that it increases towards autumn and winter and reaches its maximum for cows calving during spring. The influence of season is, however, different in different years depending on the feeding situation and the weather.

The influence of season on the duration of the ascending phase is significant in all age groups ($P < 0.01$). During the pasture season the ascending phase is 6—10 days shorter than during the indoor feeding period, whereas the ascending phases of spring and autumn calving cows are approximately of the same length. The ascending phase of first lactating cows is longer than of cows in later lactations ($P < 0.01$). JOURNET and JARRIGE (1960, p. 134), using data on cows of Norman and Friesian race in France, have observed that when the peak production increases up to 25 kg, the length of the ascending phase also increases. The ascending phase of cows in their first lactation is shorter, but the production is maintained for a longer period near the peak level than for cows in their later lactations. Also according to BLAU (1961, p. 389) the length of the ascending phase seems to increase with an increase in the peak production.

The influence of season on the yield increase tangent is negligible, which may be due to the close relationship between the peak production and the length of the ascending phase. Cows in their later lactations have a considerably more rapid yield increase than cows in their first lactation ($P < 0.01$).

The influence of season on the persistency of lactation is highly significant in all age groups ($P < 0.001$). The persistency values for cows calving during the pasture season and in the autumn are considerably higher than for spring calving cows. The average of the $P_{2:1}$ -value for the first mentioned group of cows in their first lactations is at the 90 % level; the corresponding value for the spring calving cows being at the 80 % level. The corresponding values for cows in their later lactations are 80 % and c. 70 % respectively. Thus first lactating cows during all seasons are more persistent than cows in their later lactations ($P < 0.001$). The persistency values of cows calving during the pasture season and in the autumn are on an average approximately of the same magnitude.

Several authors have observed that autumn calving cows are more persistent than cows calving during other seasons (BRUUN 1928, p. 35, AURIOL 1955, p. 195, BLAU 1961, p. 389). Besides autumn calving cows also cows calving during the winter are more persistent than cows calving during spring or summer (JOHANSSON and HANSSON 1940, p. 80, BUSSERT 1957, p. 174). For the Friesian breed in Germany FUHRKEN (1959, p. 333) observed the maximum $P_{2:1}$ -value of 90—95 % for cows calving in January and February and the minimum $P_{2:1}$ -value of 60—65 % for cows calving in June and July. During poor feeding years the $P_{2:1}$ -values of cows calving in the summer and winter differ much more than during good feeding years.

The influence of season on the 12 month production is significant for cows in their first lactation and for cows in third or later lactations ($P < 0.01$), but not for cows being in their second lactation. The lactation yield of autumn calving cows was 400—600 kg in all age groups, i.e. c. 10 % higher than the corresponding yield of cows calving in the spring or during the pasture season. On the other hand the yields of cows calving in the spring and during the pasture season on an average were approximately equally high. From the survey of literature at the beginning of this paper it appears that, according to several authors, the lactation yield of autumn calving cows is higher than the yield of cows calving in spring or summer. The winter may also be a favourable season for calving.

The superiority in lactation yield of autumn calving cows compared to spring calving cows is due to the better persistency of lactation of the autumn calving cows, but not to a higher peak production. On the other hand the superiority of the autumn calving cows over cows calving during the pasture season is due to the higher peak production of the autumn calving cows, but not to their better persistency of lactation. As the lactation yields of cows calving in the spring or during the pasture season are approximately equally high, the persistency of lactation and the peak production seem to compensate each other. In France AURIOL (1955, p. 192) has observed that in the Jura area, where the conditions for cattle breeding are uniform and good, the most favourable season of calving is October-December. The influence of the month of calving is due to the peak production, the persistency of lactation, and the length of the lactation.

The influence of season on the live weight of cows in their first lactation is negligible, but on the live weight of cows in their second and later lactations this influence is significant ($P < 0.005$). On pasture the average weight of the cows is 20—30 kg less than during the indoor feeding period, which apparently is due to the digestive tract of the cow containing less substance during the pasture season. The season does not noticeably influence the fattening condition of the cows and neither does it influence the dry period preceding the calving.

Summary

In the present paper the influence of season on the peak production, the duration of the ascending phase, the persistency of lactation, the 12 month production, and the live weight of the cows in the Ayrshire herd of the University of Helsinki experimental farm Viik are investigated. The material consists of cows calving during the period 1950—1965. During this time the indoor feeding was very intensive, satisfying all the nutritional requirements of the cows. At the same time the pastures were intensively cultivated. The size of the herd varied between 60 and 70 cows. The cows were divided into three groups: 1) spring calving cows, 2) cows calving during the pasture season, and 3) autumn calving cows.

During the pasture season the peak production of cows in first lactation is c. 2 kg and of cows in later lactations c. 3.5 kg lower than during the indoor feeding period. The peak production of spring and autumn calving cows is on an average approximately the same. The duration of the ascending phase of cows calving during the pasture season is 6—10 days shorter than during the indoor feeding period. The length of the ascending phase is approximately the same for spring and autumn calving cows. The influence of season on the yield increase tangent, which is a measure of the rapidity of yield increase, is negligible.

Cows calving during the pasture season and in the autumn are considerably more persistent in their lactations ($P_{2:1}$ -values higher) than cows freshening in the spring. The persistency values of cows calving during the pasture season and in the autumn are on an average approximately equally high. The 12 month lactation yields of autumn calving cows in the different age groups are 400—600 kg, i.e.c.

10 % higher than the corresponding values for cows freshening in spring and during the pasture season. The lactation yields of cows calving in spring and during the pasture season are on an average approximately equally high. The superiority in lactation yield of cows calving in the autumn compared to cows calving in the spring is due to the better persistency of lactation of the autumn calving cows. On the other hand the superiority in lactation yield of autumn calving cows compared to cows calving during the pasture season is due to the higher peak production of the autumn calving cows. The lactation yields of cows calving in spring or during the pasture season are approximately equally high.

During the pasture season the average live weight of the cows is 20—30 kg less than during the indoor feeding period, which is due to the smaller contents of the digestive tract of the cow during the pasture season.

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SELOSTUS:

VUODENAJAN VAIKUTUKSESTA LEHMÄN HERUMISEEN JA LYP SYKAUDEN TUOTOKSEEN VIIKIN KOETILAN AYRSHIREKARJASSA

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Kotieläintieteen laitos, Helsingin yliopisto

Tässä kirjoituksessa tarkastetaan vuodenajan vaikutusta herumishuippuun, herumiskauden pituuteen, pitkämaitoisuuteen, 12 kuukauden lypsykauden tuotokseen ja elopainoon Helsingin yliopiston Viikin koetilan ayrshirekarjassa.

Aineisto käsittää lehmät, jotka ovat poikineet aikana 1950—65. Tänä aikana sisäruokinta on ollut erittäin voimaperäinen, lehmän kaikki ravinnontarpeet tyydyttävä samalla kuin myös laitumet ovat sangen voimaperäisesti viljellyt. Karjan lehmäluku on vaihdellut 60—70. Lehmät on jaettu vuodenajan suhteen kolmeen ryhmään: 1) kevätpoikiviin, 2) laidunaikana poikiviin ja 3) syyspoikiviin.

Laidunkautena herumishuippu on ensikantoisilla lehmillä n. 2 kg ja ensikantoisia vanhemmilla lehmillä n. 3 ½ kg alhaisempi kuin sisäruokintakautena. Kevät- ja syyspoikivien lehmien herumishuiput ovat keskimäärin suunnilleen samansuuruiset. Herumiskausi on laidunaikana poikivilla 6—10 päivää lyhyempi kuin sisäruokintakautena. Kevät- ja syyspoikivien lehmien herumiskaudet ovat keskimäärin suunnilleen samanpituiset. Vuodenajalla ei ole mainittavaa vaikutusta herumistangenttiin, joka kuvaa herumisen nopeutta.

Laidun- ja syyspoikivat lehmät ovat huomattavasti pitkämaitoisempia ($P_{2,1}$ -arvo suurempi) kuin kevätpoikivat. Laidun- ja syyspoikivien lehmien pitkämaitoisuusarvot ovat keskimäärin suunnilleen yhtä suuret. Syyspoikivilla 12 kuukauden lypsykauden maitotuotos on eri ikäluokissa 400—600 kg eli n. 10 % suurempi kuin kevät- ja laidunpoikivilla lehmillä. Kevät- ja laidunpoikivien lehmien lypsykauden tuotokset ovat keskimäärin suunnilleen samansuuruiset. Syyspoikivien lehmien lypsykauden tuotoksen suuremmuus kevätpoikiviin verrattuna johtuu syyspoikivien lehmien paremmasta pitkämaitoisuudesta. Sensijaan syyspoikivien lehmien lypsykauden tuotoksen suuremmuus laitumella poikiviin verrattuna johtuu syyspoikivien korkeammasta herumishuipusta. Keväällä ja laitumella poikivien lehmien lypsykauden tuotokset ovat suunnilleen yhtä suuret.

Laitumella lehmien keskimääräinen elopaino on 20—30 kg pienempi kuin sisäruokintakautena, mikä johtuu ruoansulatuskanavan sisällön pienemmästä määrästä laidunkautena.